THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 72 OCTOBER, 1954 No. 4

CONTENTS

Modification of Radiation Injury in Experimental Animals. JANEWAY LECTURE, 1953. LEON O. JACOBSON, M.D. 543

The Roentgen Aspects of Five Hundred Cases of Pulmonary Coccidioidomycosis. J. W. BIRSNER, M.D. 556

Renal Arteriography. ARTHUR T. EVANS, M.D., F.A.C.S. 574

Abdominal Aortography for the Roentgen Demonstration of the Liver and Spleen. LEO G. RIGLER, M.D., AND PAUL C. OLFELT, M.D. . . 586

Translumbar Arteriography in Intrinsic Disease of the Abdominal Aorta and Its Branches. BENJAMIN FELSON, M.D. 597

Gastric Volvulus. Part I. CHARLES GOTTLIEB, M.D., DAVID LEFFERTS, M.D., AND SAMUEL L. BERANBAUM, M.D. 609

Gastric Volvulus. Part II. Idiopathic Gastric Volvulus. DAVID LEFFERTS, M.D., SAMUEL L. BERANBAUM, M.D., AND CHARLES GOTTLIEB, M.D. 616

Gastric Volvulus. Part III. Secondary Gastric Volvulus. SAMUEL L. BERANBAUM, M.D., CHARLES GOTTLIEB, M.D., AND DAVID LEFFERTS, M.D. 625

Roentgen Diagnosis of Gallbladder and Biliary Tract Disease without Cholecystography. ROBERT L. SCANLAN, M.D., AND BARTON R. YOUNG, M.D. 639

Leiomyosarcoma of the Prostate. Case Report. RALPH C. AYE, M.D., THOMAS W. DORR, M.D., AND NOEL G. SHAW, M.D. 644

Visualization of Coronary Sinus Graft and Venous Pathways of the Heart in Living Dogs. ARAN S. JOHNSON, M.D., PAUL G. FIRNSCHILD, M.D., AND HAROLD FULTON, M.D. 648

A Pneumatic Remote Control Precision Injector for Interstitial and Intracavitary Injection of Radioactive Colloidal Gold. S. TAPLITS, M.D. . 655

A Technique for Evaluating the Effectiveness of Localization of Radioactive Colloidal Gold-198 After Direct Injection into Tumors. JOHN U. HIDALGO, M.S., EDGAR BURNS, M.D., AND ROBERT T. NIESET, PH.D. 658

The Use of Radioactive Isotopes for Diagnostic Radiology. G. E. DENNIS AND H. A. DELUCA 661

Comparison of Radiotherapy Abroad and in the United States. Robert E. Fricke, M.D. 666

Editorials

Progress in the Roentgen Visualization of the Biliary Tract. Harold Fulton, M.D. 671

I. González Martínez, 1871–1954. Rafael A. Blanes, M.D. . . . 673

Carl Darnell 675

Society Proceedings, Correspondence and News Items 677

Book Reviews 684

Books Received 687

Abstracts of Radiological Literature 689

LEON O. JACOBSON

Janeway Lecturer, 1953

THE AMERICAN JOURNAL OF ROENTGENOLOGY
RADIUM THERAPY AND NUCLEAR MEDICINE

VOL. 72 OCTOBER, 1954 No. 4

MODIFICATION OF RADIATION INJURY IN EXPERIMENTAL ANIMALS

JANEWAY LECTURE, 1953*

By LEON O. JACOBSON, M.D.

Argonne Cancer Research Hospital and the Department of Medicine, The University of Chicago

CHICAGO, ILLINOIS

I AM honored to speak to you today as the eighteenth Janeway Lecturer and wish to express my gratitude to the members of the committee who have chosen me to address the American Radium Society in this role.

It was not my fortune to know Henry Janeway, yet I am immensely indebted to him, who, as a cancer therapist, did some rather basic research on the clinical application of ionizing radiations and on related problems of dosimetry. His was one of the early and fruitful attempts to bring about a close association between the medical practitioner and the physicist. He was, in point of fact, one of the first radiobiologists. The efforts of Janeway and his associates are a part of the groundwork for many of the investigations that are currently under way on the biological effects of the various radiations, the alteration of these effects, and the therapeutic potentialities of the radiations as such.

I humbly approach the honor you have bestowed upon me today and only hope that I can contribute in some small way to the memory of Henry Harrington Janeway.

The subjection of a mammal to midlethal or lethal amounts of roentgen rays, gamma rays, or fast neutrons results in the appearance of some characteristic symptoms that have been described as the radiation syndrome.[13,19,20,27,29,32,42] Recognition of this syndrome has led quite naturally to attempts to alter it, and investigations for this purpose range from studies of structures within the cell to those of the whole multicellular organism. Such agents as chemicals and biologicals, and the initiation of other measures, prior, during, or after irradiation, are being employed to influence radiosensitivity.

The survival of rats and mice is markedly increased if estrogen,[40] cysteine,[34] or glutathione[9] is given prior to the administration

* The eighteenth Janeway Lecture, delivered at the Thirty-fifth Annual Meeting of the American Radium Society, St. Louis, April 20–22, 1953. Papers on the same subject were also presented at the Twenty-sixth Annual Graduate Fortnight of the New York Academy of Medicine, October, 1953, and the CIBA Foundation Conference on Experimental Leukaemias, London, November, 1953. The manuscripts have only minor differences in text and illustrative material.

of a lethal amount of whole body roentgen radiation. Another sulfhydryl compound, cysteinamine,[1,36] has been found to have an even more striking effect than cysteine. Likewise, animals that are subjected to severe oxygen deprivation[10] or cyanide intoxication[2] during lethal irradiation also have reduced mortality. Neither the pre-irradiation measures nor those instituted during irradiation, however, have any beneficial effect on survival if they are instituted after the animals have been given lethal exposures.

Patt[33] has written a comprehensive review covering the literature on the in vivo and in vitro biochemical and physiologic effects and has summarized current concepts of the mechanism of action of ionizing radiations.

This lecture is devoted almost solely to measures that, when initiated after exposure of the mammal to an LD100, have a remarkable effect on survival and on recovery of the blood-forming tissue. Since a review of our investigations in this field has been published,[14] I shall describe only a few of our studies to show you how each investigation led to another, and to bring to your attention certain interesting but as yet undeveloped observations.

Three possible explanations for the success of our techniques evolved quite early in the course of our research. These are (1) the neutralization of a toxin produced by irradiation; (2) the cellular seeding of depleted irradiated tissue; or (3) a humoral factor or factors produced and supplied by cells to the irradiated tissue. Thus, many of the experiments that I shall describe were efforts to evaluate these possibilities. Other experiments, however, were undertaken to provide basic information on hematopoiesis quite apart from radiation injury.

Interest in the spleen as an important locus of erythropoiesis developed during the course of some experiments on the effects of radiostrontium in mice.* Animals that were given Sr^{89-90} (2.0 μc./gm.) did not develop anemia although their bone marrow became completely aplastic within a few days after injection and remained so for more than a month. The lymph nodes became moderately active centers of hematopoiesis, but the spleen became the site of intensive erythropoietic activity. A severe and persistent anemia, which had been predicted, developed in splenectomized mice that had been injected with similar amounts of Sr^{89-90}.[24] Since strontium is almost exclusively a bone seeker, the lymphatic tissues, including the spleen, were essentially unaffected by its beta radiation and therefore had the capacity to respond to the demand created by the destruction of bone marrow. Leading from this was the question of the nature and mechanism of the stimulus to the hematopoietic tissue of the spleen. The splenic erythropoietic transformation occurred in the absence of an anemia and within three days! Another question that intrigued us was what would happen if, by some technique, we could destroy all blood-forming tissue in the body except that located in the spleen. This gave impetus to our spleen-shielding experiments.

Lead shielding of the surgically exteriorized spleen of adult mice during total body roentgen irradiation markedly enhances survival (Fig. 1).[17] The survival of mice in which the circulation to the shielded spleen is clamped off during exposure and in which the clamp is released immediately after irradiation is approximately the same as the survival of animals with spleen shielding without clamping.[14,25,26] The LD50 for total body roentgen radiation is 600 r and the LD99 is around 700 r without spleen shielding, whereas with spleen shielding the LD50 is 1,100 r and the LD99 is greater than 1,300 r.[26] Histologic and hematologic studies have been made on animals that were exposed to 600 r, 900 r, 1,025 r, or 1,300 r. After 1,025 r or 1,300 r, recovery is more rapid and complete in spleen-shielded mice than in mice exposed to 600 r without spleen shielding (Fig. 2). No anemia and

* Mice used in these experiments were CF No. 1 females, 10–12 weeks old, raised by Carworth Farms—homozygous for recessive genes aa, bb, cc.

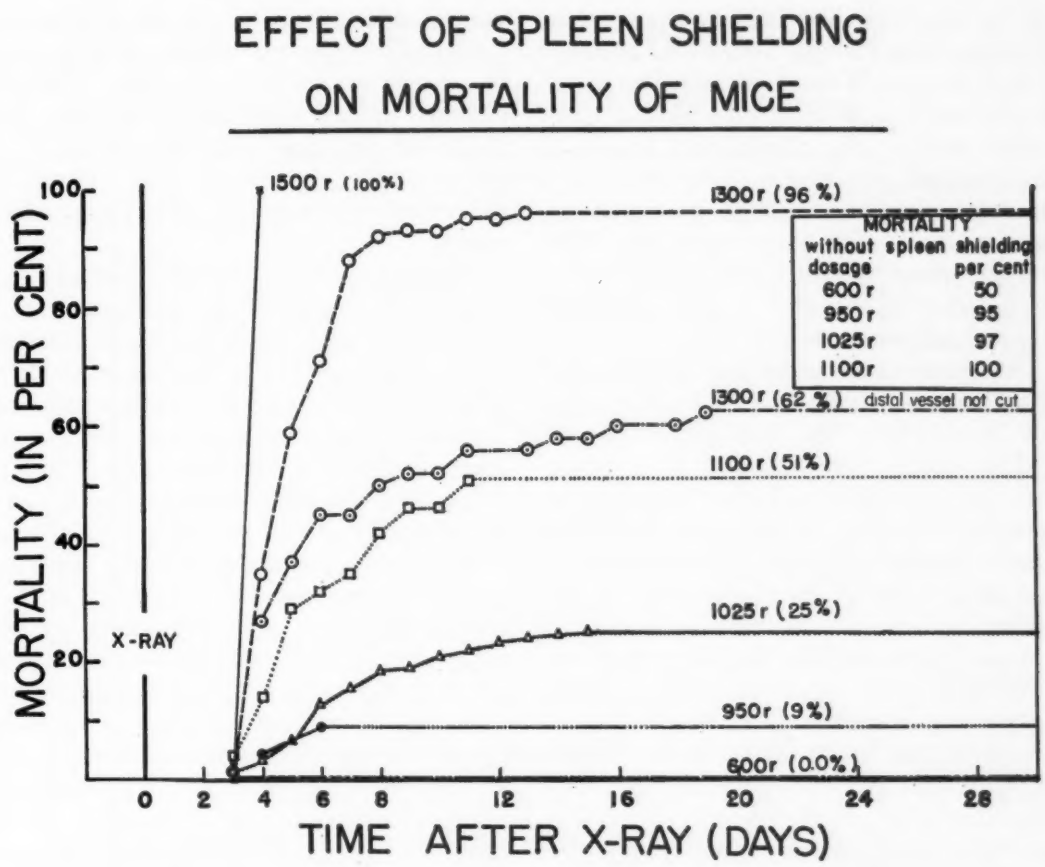


FIG. 1. The effect of spleen shielding on the mortality of mice following whole body roentgen irradiation.

only a transient leukopenia and thrombocytopenia follow an exposure to 1,025 r with spleen shielding, whereas pancytopenia and death follow this exposure without spleen shielding.

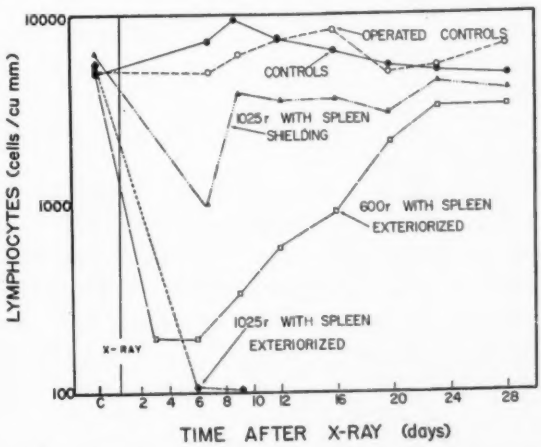


FIG. 2. Comparative effects of 600 r whole body irradiation without spleen shielding, and 1,025 r with spleen shielding on the lymphocyte response of mice.

The characteristic picture of destruction and atrophy that follows exposure to 1,025 r was seen in both the spleen-shielded and non-spleen-shielded animals; recovery of bone marrow and lymphatic tissue began at four days and was complete by eight days in spleen-shielded mice, but no hematopoietic recovery was noted during this interval in non-spleen-shielded mice.[16] The prominence of heteroplastic activity in the bone marrow was considered to be particularly significant, and I shall discuss this a little later.

Shielding of other parts of the body of the mouse, such as a leg, a fraction of the liver, or the intestine, during roentgen irradiation in the lethal range (1,025 r) in-

creases survival, but less so than spleen shielding, even though the volume shielded in each instance is much greater. For example, the survival of mice subjected to 1,025 r with part of the exteriorized liver (0.8 gm.) shielded with lead is approximately 30 per cent compared with 76 per cent survival of mice with spleen shielding. The average spleen weight in these mice is 0.1 gm. Lead shielding of 0.19 gm. of kidney does not enhance survival.

That postradiation therapy for radiation injury was feasible was evidenced by the fact that when the circulation of the shielded spleen was released to a mouse that had sustained a lethal exposure to roentgen radiation, it survived. Intensive blood formation, beginning at the twenty-four hour interval, was observed in the shielded spleens of the heavily irradiated animals. Serial sacrifice disclosed that erythropoiesis took precedence over other types of blood formation in the spleen. In fact, even the lymphatic nodules of that organ disappeared in some mice, and only the central artery of the nodule remained at the site of the original nodule. The entire spleen was transformed essentially into an erythropoietic organ and remained so for several days before granulocytopoiesis and megakaryocytopoiesis became evident. Teleologically, one would have expected the reverse to occur, because, theoretically, an animal that was not anemic would not need erythrocytes. Leukocytes to combat infection and platelets to insure capillary integrity and hemostasis were more likely requisites.

Whatever was saving the life of the irradiated animals appeared to have its source in the hematopoietic system because spleen shielding was so much more effective in increasing the survival of mice and hastening the recovery of the blood-forming tissue than was the shielding of other body parts.

Whether survival was increased because the shielded spleen immediately took over blood formation and thus saved the animal from death due to pancytopenia and its complications was a pertinent question. Consequently, experiments were designed to determine how long the originally shielded spleen must remain in the circulation of the irradiated animal to insure survival. The answer was found in a series of investigations on the effect of splenectomy.

Splenectomies were performed at intervals, beginning at fifteen minutes after irradiation, on groups of mice that had been exposed to 1,025 r with spleen shielding (Fig. 3). If the spleen remained in the body for only fifteen minutes, survival was increased. However, these animals developed a pancytopenia that was of greater severity and duration than that observed in animals in which the spleen was removed after one hour had elapsed. In those animals in which the spleen was left intact for one hour, survival (78 per cent) was comparable with that of mice given routine spleen shielding. It was noted that recovery of blood-forming tissue was more rapid and more complete in the animals in which the spleen remained in the circulation for the thirty-day period of observation (Fig. 4).

We routinely severed a small vessel at the distal end of the spleen to exteriorize the organ for the shielding procedure. This practice left the main pedicle intact, but up to one-half of the distal portion of the spleen was always infarcted. The survival of mice subjected to this exteriorization technique and 1,300 r was 3.2 per cent, whereas survival was 31.2 per cent if the small vessel was left intact and no splenic infarction occurred.

Sometimes during the spleen-shielding procedure the entire splenic circulation was embarrassed if the spleen was twisted or the pedicle was stretched. When either happened, the deeply cyanotic appearance indicated that infarction of the entire organ would likely or had already occurred. Many of these animals lived. Sacrifice of some of these animals at appropriate time intervals proved to our satisfaction that infarction of the entire spleen had occurred and that splenic reconstitution began as the

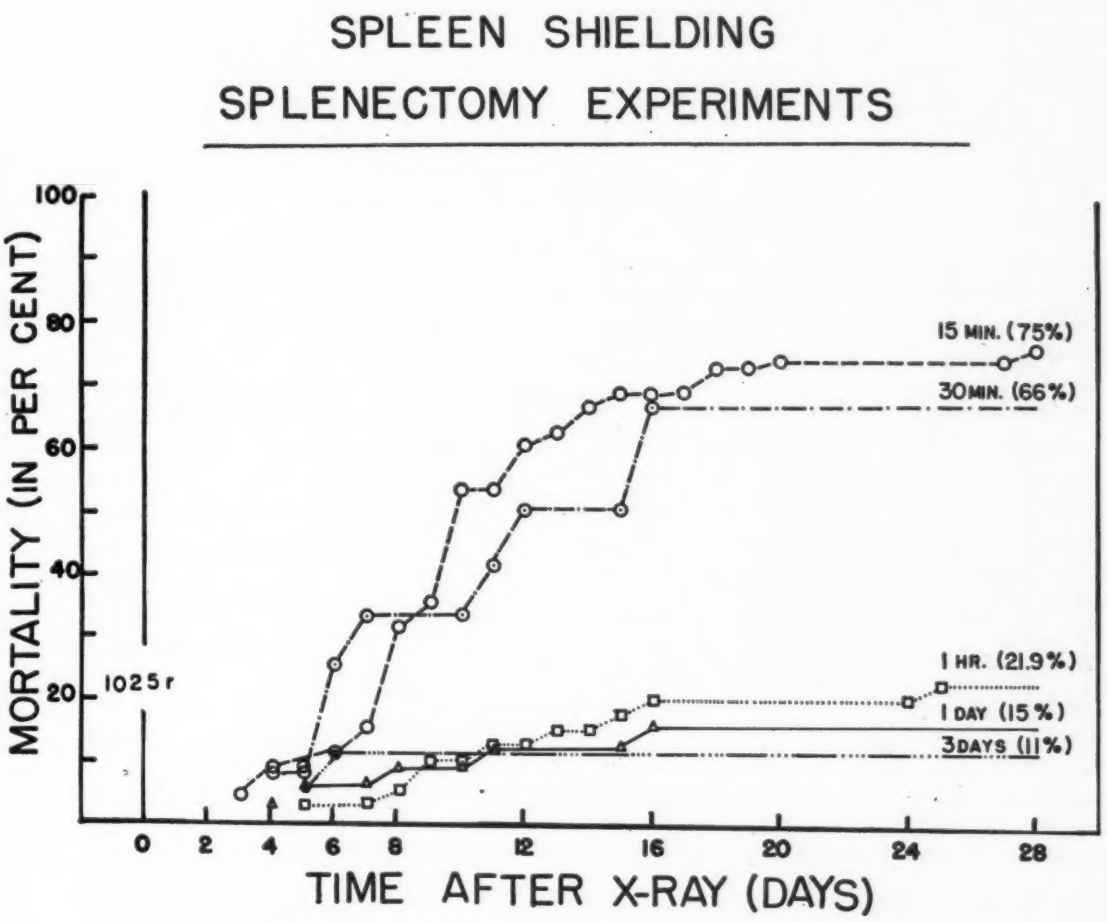


Fig. 3. The effect of postirradiation splenectomy on the mortality of spleen-shielded mice.

blood supply to the spleen was re-established. Since the partially reconstituted spleen had the capacity to initiate the recovery process, splenic transplants thus appeared to be an effective means of bringing about the recovery of irradiated animals. If the irradiated hosts could establish a circulatory exchange with the transplant, then the procedure should increase survival and effect recovery of blood-forming tissue.

Early attempts using spleens from adult mice for the transplants failed. This was assumed to be due to the fact that adult spleens, placed randomly in the peritoneal cavity, do not usually develop a vascular supply. Later, we discovered that if the capsule of the transplanted adult spleen was cut before it was placed in the peritoneal cavity, it vascularized and significantly enhanced survival. The initial failure with mature spleens prompted a trial with the spleens from baby mice. Spleens (10 to 50 mg.) from normal baby mice, ranging in age from one to twelve days, were implanted intraperitoneally through a small slit in the abdominal wall of mice that had been exposed to 1,025 r total body roentgen radiation. No attempt was made to anchor the implant. Thirty-eight per cent of the irradiated hosts survived (Table 1). Even if the animals received the spleens as late as two days after irradiation, appreciable survival was observed (25 per cent).

We were able to relate the quantity of tissue, which the irradiated mouse received, to survival. For example, there was 38 per-

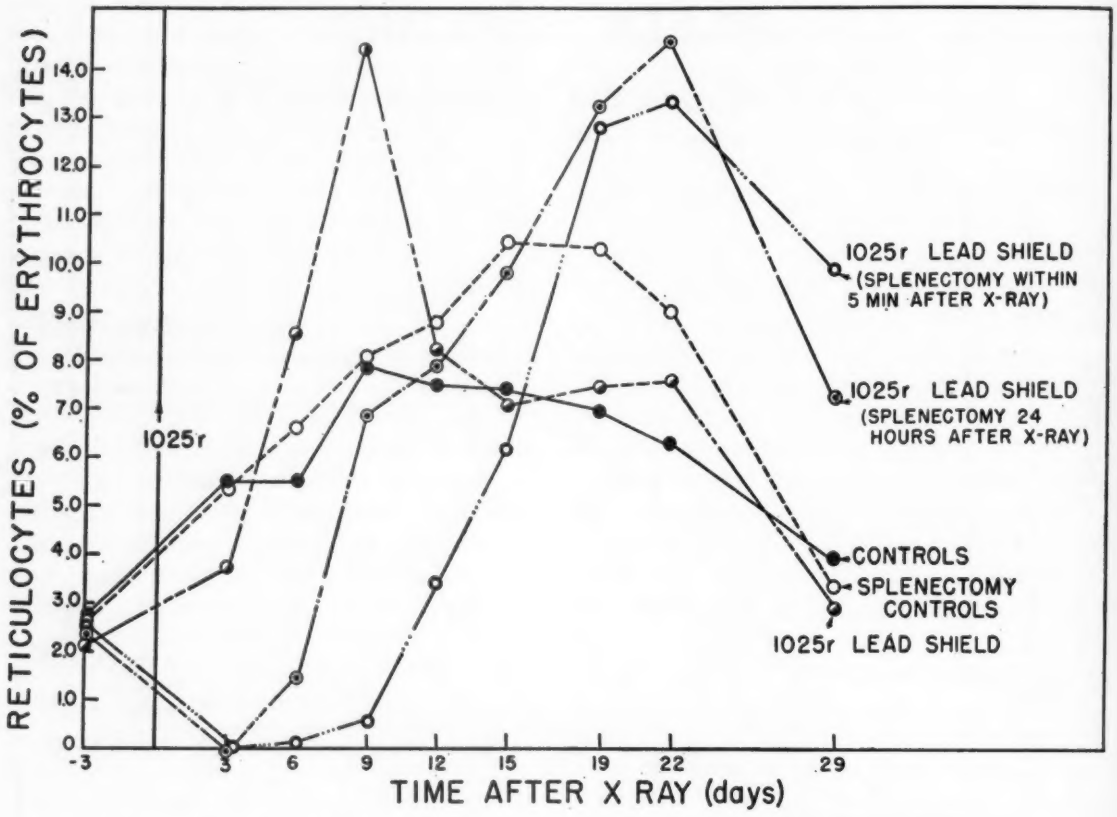


Fig. 4. The effect of postirradiation splenectomy on the reticulocyte response of mice.

cent survival with 10 mg. of baby spleen but none with 5 mg. This was to be expected since survival had been found to be less in animals in which a partial splenic infarction had been produced deliberately than in animals in which no splenic infarction had occurred.

Table I*

THE EFFECT OF SPLEEN IMPLANTS ON THE SURVIVAL OF IRRADIATED MICE

Number of Mice Used	Spleen Implants within ½ Hour after Irradiation	Survival (%)
112	None	0
63	4 spleens from 1- to 12-day-old mice	38
18	2 spleens from 4- to 5-week-old mice	45
24	4 spleens from 1- to 8-day-old mice implanted 2 days after irradiation of the recipient	20

* Reproduced by permission from *Science*, 1951, *113*, 510–511.[25]

These observations on survival and others on recovery of blood-forming tissue were considered to be evidence of a quantitative relationship between the amount of tissue furnishing the necessary factor or factors to the irradiated animal and its survival or recovery from irradiation.

One of the experiments in which baby spleens were transplanted yielded some especially interesting results. Mice were exposed to 1,025 r total body roentgen radiation and were each given intraperitoneally four baby spleens. When the animals were autopsied, there was no trace of the original transplant in 4 of 12 mice that survived the twenty-eight day period of observation. In 1 of the 12 mice only one splenic transplant was found; in 3 of the mice, two were found; in 1, three of the transplanted spleens were found; and in 3 of the mice, four spleens were found.

It may be that the transplants vascu-

Table II

THE EFFECT OF EMBRYO SUSPENSIONS ON THE SURVIVAL OF IRRADIATED MICE

Group	Number of Mice	Roentgen-Ray Exposure (r)	Embryo Suspension	Survival (%)
Control	123	1,025	No	0.8
Treated	123	1,025	Yes	30.0

larize temporarily and are later detached and removed by phagocytosis, or that cells from the splenic transplant migrate out before death and absorption of the transplant occurs. Whatever the fate of the transplant, it effectively alters the fate of the animal.

Study of the effectiveness of embryo and spleen preparations was stimulated when we observed that splenic transplants from baby mice increased survival and that mice occasionally survived a lethal exposure even though the transplanted tissue could not be found. Mouse embryos (fourteen to twenty day), taken by cesarean section, were ground in saline and administered intraperitoneally to mice exposed to 1,025 r. Survival was found to be about 30 per cent (Table II)[14]

Spleens from one- to nine-day-old mice were mashed through a tissue press and suspended in buffered saline. Mice that had been exposed to 1,205 r and then injected intraperitoneally with this suspension did not survive. In point of fact, these mice died earlier than was expected from the irradiation alone. If, however, the mice were exposed to 800 r, an intraperitoneal injection of this material significantly increased survival.[16] Lesser amounts of the suspension were later found to reduce the toxicity of the preparation and decrease mortality following exposure to 1,025 r. The toxicity of splenic suspensions is reduced if the cells are extracted from the spleen immediately after it is removed from the body of the donor mouse. To do this, the cells may be washed from the spleen by multiple injections of saline or Locke's solution, by gently mashing the spleen in a mortar, or by pushing the splenic tissue through a 2 cc. syringe. Survival is approximately 75 per cent in animals exposed to 900 r and then given an intravenous injection of splenic cells suspensions prepared by any of these methods.

Our attention was directed to the so-called reticuloendothelial system as the richest source of the effective substance or substances[14] by the fact that survival of the irradiated animal is not altered by control transplants, suspensions, or the shielding of such tissues as muscle, kidney, or placenta, whereas it is increased by transplants or shielding of major blood-forming tissues such as liver, spleen, or leg. Bone marrow transplants and injections, which had been tried previously and reported of no value in dogs,[35,39] were thus suggested as the next avenue for investigation.

The efficacy of bone marrow in reducing the mortality of irradiated mice was first reported by Lorenz *et al.*[30] who found that 75 to 90 per cent of mice given a single exposure to 900 r survived if, after irradiation, they were injected intravenously with a suspension of homologous bone marrow. In addition to corroborating their findings, we found[14] that the intravenous injection of bone marrow cells also significantly increases the survival of mice exposed to 1,025 r. An assessment is in progress of the optimum and minimum number of cells from bone marrow, spleen, or embryo suspensions that will decrease mortality significantly. Results from preliminary studies are indicative that cell suspensions of the soft portions of the embryo are more effective than suspensions of spleen or bone marrow. Each preparation that is used for these studies is adjusted in such a way that a comparable number of cells from each source is administered. The variability in results with different numbers of cells from bone marrow, spleen, or embryo suggests that the type of cells in the injected suspension may be a determining factor. For example, the endosteal, reticular, and endothelial cells may be of greater importance in initiating recovery than erythroblasts,

myelocytes, and megakaryocytes. Preparations from the various sources are being studied to determine actual cellular make-up and the proportions of the constituent cells. We may then be able to relate cell type to survival.

Survival studies on irradiated rabbits that had been treated with baby mouse spleen transplants indicated that regeneration of the hematopoietic system of the rabbit was stimulated by this procedure.[14] It has more recently been demonstrated by Lorenz and Congdon that the intravenous administration of guinea pig bone marrow[28] or rat bone marrow[8] markedly increases the survival of mice that have been exposed to lethal amounts of roentgen radiation. We have corroborated their findings on the effectiveness of rat marrow in mice.[18]

I have already stated that the fate of individual injected cells is not known with any degree of certainty. Whether suspensions of heterologous and homologous bone marrow or (washed) spleen cells implant in the body and live a "normal life span," or whether these cells function only temporarily as normal cells is an open question. For example, we do not know whether the rat hematopoietic cells that are injected into an irradiated mouse function in phagocytosis and divide and multiply. These cells, by some mechanism, however, succeeded in altering the pathologic state of the irradiated animal to the extent that the animal recovers.

Recovery of the blood-forming tissue may initiate or foster the recovery process in irradiated animals treated by one of the various techniques under discussion. We know that recovery of bone marrow and lymphatic tissue is initiated under these circumstances by four days after irradiation (perhaps earlier if methods of studying functional reconstitution of cells become more refined) (Fig. 5). Miller *et al.*[31] have shown that the normal function of these tissues is essential to combat infection. By way of speculation, however, one might logically raise the question of why the overwhelming infection, which is described, comes relatively late after lethal irradiation tion, while destruction of the blood-forming tissue is manifest soon afterward. Is the animal protected against bacterial invasion during the first week after irradiation by some mechanism or agent that is quite apart from the hematopoietic tissue?

One must not conclude from this that because blood-forming tissue does recover, it is the only one vital to survival. Such tissue as that in the liver may also be important. The development of more sensitive methods to study the inhibition and recovery process of these tissues in vivo after irradiation may be quite revealing. In fact there is now good evidence that recovery of blood-forming tissue is not the sole factor essential to recovery. The data that I mentioned previously support this; namely, that only about 30 per cent of animals survive 1,300 r with spleen shielding and preservation of the entire splenic circulation, whereas 3.2 per cent survive if the spleen is shielded and only part of the splenic pedicle is preserved. In the splenic circulation group there should be almost 100 per cent survival if recovery of blood-forming tissue were the only factor involved.

Williams and his associates[41] have reported experiments in which the entire body of the rat was shielded except for an exteriorized segment of the small intestine. The rate of recovery of the intestinal epithelium in this segment was not appreciably different from that observed in control non-shielded animals. Their work implies that recovery of intestinal epithelium, or failure to recover from radiation injury, is largely, if not entirely, unrelated to the state of the blood-forming tissue. These observations emphasize the limitation of the "therapeutic" techniques described in this paper and direct our attention to other systems that are basic to recovery from radiation injury.

The radiosensitivity of cells in various tissues in the body, such as the brain, thyroid, and gonads, varies widely. Cells derived from a single source, such as the reticulum of the blood-forming tissue, have

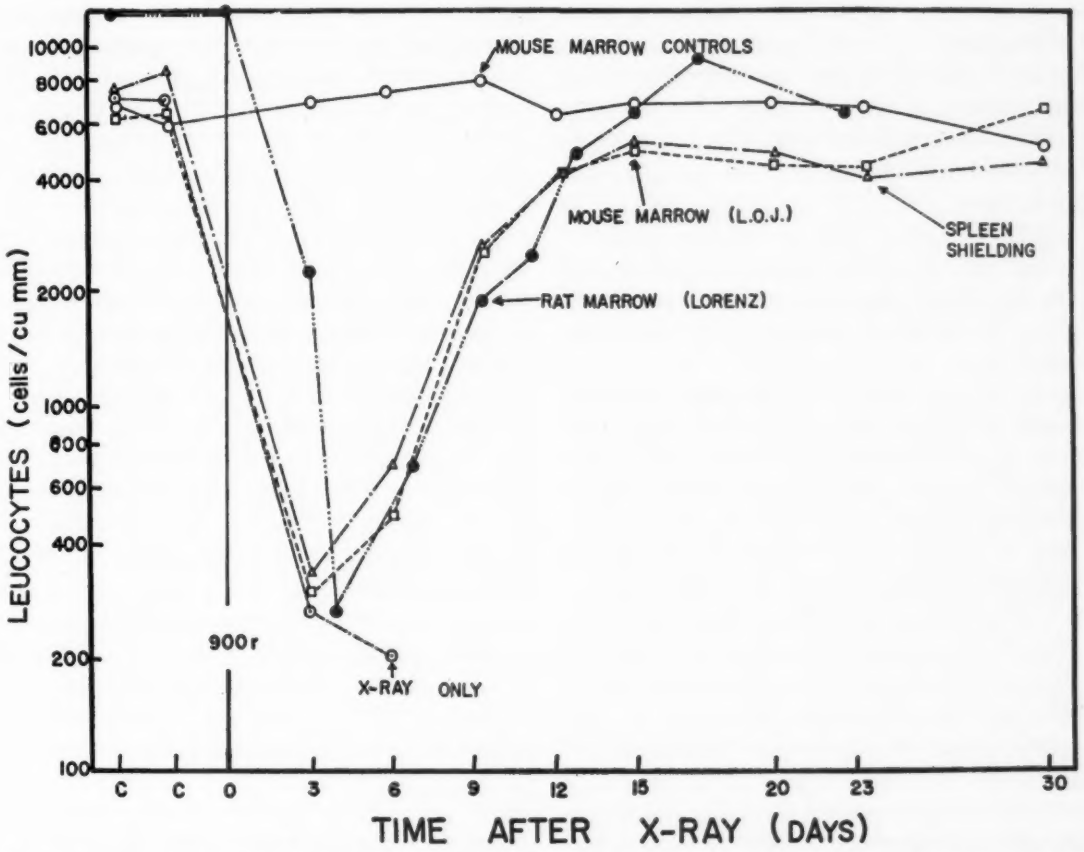


FIG. 5. A comparison of the effects of homologous and heterologous bone marrow injections and spleen shielding on the leukocyte response of mice exposed to 900 r roentgen radiation. (The data on rat marrow added to the figure are from paper by Congdon and Lorenz.[8])

different radiosensitivities.[5] There is evidence to show that within a single cell the various functions and processes have different radiosensitivities. For example, reticular cells are capable of phagocytosis. This function is extremely radioresistant, and, on the basis of histologic observations, exposures above 1,000 r do not seem to affect it, whereas the heteroplastic or homoplastic multiplication process is inhibited by about 500 r. It may also be assumed that with increasing exposures not only are more and more functions of the reticulum eliminated, but other cells in the body are similarly affected.

Prophylactic agents such as estradiol and cysteine combined with post-irradiation measures, such as spleen shielding, have an additive effect on survival.[4,37] The findings, however, do not necessarily imply that the mechanism of action of both procedures is identical.

Although we have tried to obtain a cell-free extract of spleen, embryo, or bone marrow that would increase the survival of irradiated mice, our results have been only negative or equivocal. Simple buffered saline extracts of spleen, bone marrow, or embryo, or homogenized preparations of such tissue are ineffective if the material is filtered so that no cells or parts of cells are present.

Cole and his co-workers[6,7] claim to have prepared suspensions of mouse spleen cells with only the nuclei of the cells intact. According to their report, the intraperitoneal administration of these preparations to roentgen irradiated mice routinely increases survival. If, indeed, these suspensions contain no intact cells and thus no living cells

in the ordinary sense, then additional proof for the humoral theory is at hand. The need for a simple and sensitive method to assay the activity is obvious since identification of the effective substance or substances in the whole cell or the nucleus has not been made. Survival following lethal exposure to radiation is being used as the yardstick for measuring the effectiveness of various cell suspensions or preparations free from living cells. This method appears to be much too insensitive.

The phenomenon of hastened hematopoietic recovery as well as increased survival in animals roentgen irradiated in the mid-lethal or lethal range with spleen shielding is not confined to the mouse. Lead shielding of the spleen of rats, guinea pigs, and rabbits during mid-lethal exposures is followed by a more rapid recovery of the hematopoietic tissue and a reduced mortality. However, there is a pronounced difference in the species response to the techniques under discussion. Spleen shielding in the mouse, for example, spectacularly increases survival and markedly hastens the recovery of blood-forming tissue, whereas a definite but only minimal effect is observed in the rabbit. This may be due to a quantitative difference in the capacity of the rabbit spleen or appendix to produce the substance or substances necessary for the recovery process.

There are also strain differences. Studies of six different strains of mice have revealed that spleen shielding or injection of suspensions of hematopoietic cells after total body roentgen irradiation effectively increases survival of all of the strains and hastens hematopoietic regeneration, and that bone marrow, spleen, or embryo suspensions from one mouse strain are effective in another strain. However, in one particular strain (CF No. 1), the LD50 with spleen-shielding is about 1,100 r whereas in another mouse strain (Webster) it is 1,000 r.

It is well known from Hektoen's studies[11,12] that total body roentgen irradiation inhibits antibody formation in laboratory animals. The capacity of rabbits exposed to 800 r total body roentgen radiation with spleen or appendix shielding to produce antibodies in response to an intravenously administered particulate antigen is retained, whereas without shielding this capacity is suppressed.[23] As a matter of fact, we found that the antibody response to an injected antigen is retained in irradiated rabbits even though the originally shielded spleen is removed twenty-four hours after the shielding-irradiation procedure and the antigen is given forty-eight hours after the exposure (twenty-four hours after splenectomy).[21] In these studies, the antigen was administered (both in the experimental and control animals) when the cellular hematologic constituents of the peripheral blood were greatly reduced, cell death and phagocytosis of hematopoietic tissue was continuing, and there was no evidence of regeneration. Nevertheless, antibody formation was initiated in the spleen-shielded splenectomized animals but not in the non-spleen-shielded animals. Our more recent data indicate that the shielded spleen need only remain intact in the circulation of the rabbit for three hours after total body roentgen irradiation to restore the capacity to produce antibodies.[22]

I shall repeat our theories on the reasons for the success of our techniques at this time so that I may discuss them more fully. These are:

1. Detoxification of substances produced by irradiation.
2. Cellular seeding and tissue reconstitution.
3. Production of a humoral substance that initiates functional reconstitution of cells.

It has long been assumed that irradiation produces a toxin that has an inhibitory effect on metabolic processes within the irradiated cells. Transport of this "toxin" from the irradiated site to other parts of the body is presumed also to inhibit cellular processes at distant nonirradiated sites. Hydrogen peroxide, produced along the path of ionization, has been suggested as the noxious agent.[3] It is conceivable that

the local and distant effect may be the result of the action of this or some other oxidizing substance. However, if this is true, one must assume that the production and dissemination of such a substance and the initiation of the biologic effects occur within a relatively short time after the initial radiation stimulus is applied and that the "toxin" is then destroyed or neutralized. Evidence for this is briefly as follows. After the administration of lethal amounts of radiation to groups of mice with or without spleen shielding, the initial pathologic effects are identical, *i.e.*, destruction and atrophy of the lymphatic tissue and bone marrow proceed in both experimental groups at the same rate and reach the same maximum. The observable difference in the two groups is that recovery of the blood-forming tissue begins by the fourth day in the spleen-shielded group and about 75 per cent of animals survive, whereas there is little or no histologic evidence of recovery of the blood-forming tissue in the non-spleen-shielded group and death is inevitable. If one removes the spleens from the animals in these two experimental groups one hour after irradiation, survival and recovery of hematopoietic tissue is nil in the non-spleen-shielded group, whereas survival is 75 per cent and recovery of hematopoietic tissue begins at four days in the spleen-shielded animals. If a toxin is indeed responsible for the destruction and continued inhibition of cells, it must be a transitory one or it would continue to act beyond the one hour during which the spleen is left intact in the circulation in the spleen-shielded group, and these animals would not be expected to recover. It seems unlikely but it cannot be denied, however, that while the spleen is in the circulation it may continue to neutralize the toxin and that after the organ is removed, its cells, which were disseminated throughout the body, carried on the detoxification process. This aspect will be discussed more fully.

Another interesting observation that might be used as evidence against the continuing production and dissemination of a toxin is that the injection of spleen cells or bone marrow reverses the otherwise lethal effect of radiation even when either is administered two or three days after an animal has been exposed to a lethal amount of radiation.[15] If a specific toxin were entirely responsible for the destruction and continued atrophy and inhibition of cells and organ systems, one might logically expect an increasing pathologic state. Storer and Lushbaugh[38] have suggested that the effectiveness of shielding as related to the capacity of the shielded tissues to forestall infection until the tissues of the body, and especially the blood-forming tissue, can regenerate spontaneously. This seems an untenable explanation for a number of reasons, one of which is the fact that the shielded spleen of the mouse can be removed an hour or less after the administration of a uniformly lethal total body exposure and yet the animal survives. The effectiveness of heterologous cells (rat to mouse, guinea pig to mouse, and mouse to rabbit) in bringing about recovery makes Storer's postulate even more untenable, unless such heterologous cells function in the new host in a manner largely comparable to normal homologous cells in terms of combating infection and the like.

The theory that shielded tissue and injected hematopoietic cell suspensions may bring about a reversal of the lethal effects of radiation by seeding destroyed hematopoietic tissue throughout the body is attractive but seems unlikely. The effectiveness of heterologous tissue makes this theory rather remote. We cannot overlook the data from histologic observation that indicate that hematopoietic regeneration in the bone marrow from reticular cells and osteoblasts is prominent in spleen-shielded mice and in mice injected with cell suspensions. If seeding via the blood stream and subsequent regeneration by multiplication of cells is a factor in the regeneration, then release of the inhibition of the reticular cells, allowing them to multiply, would still have to be explained.

It appears reasonable that the end result of lethal irradiation represents a chain of events set off by the release of such an

agent as hydrogen peroxide, and that the profound effect of spleen-shielding, or injection of such materials as embryonic tissue, spleen, or bone marrow cells, and the like could best be explained by assuming that these cells or tissues provide one or more of the metabolites necessary for the functional reconstitution of the injured cells. Cole's observations[6,7] and the effectiveness of heterologous tissue materially strengthen this hypothesis.

In closing, I should like to summarize our reasons for accepting the humoral theory as the explanation for the increased survival that we have found in our studies on the modification of radiation injury. Whole body exposure to ionizing radiations in the lethal or mid-lethal range produces widespread destruction of certain tissues in the body such as blood-forming tissue, the gastrointestinal tract, and the gonads. Death may be related to injury of one or more tissues and organ systems, but the destruction and delayed recovery of blood-forming tissue is considered to be one of the more critical. A number of prophylactic measures such as the injection of cysteine and glutathione just prior to irradiation will reduce mortality. These materials have no beneficial effect if given afterward. Measures that in effect are instituted after lethal irradiation, *e.g.*, spleen shielding or the injection of spleen cells, suspensions of spleen or embryo cells, and bone marrow, increase survival and hasten recovery of blood-forming tissue. The mechanism of this striking effect is unknown. The possibilities considered are (1) detoxification of some radiation-produced toxin; (2) seeding of the animal with injected cells that multiply and repopulate tissue such as the bone marrow; and (3) production of a humoral substance or substances by the shielded or injected cells that brings about functional reconstitution of the inhibited cells and initiates regrowth of vital tissues. On the basis of a number of observations, including the pattern of histologic recovery in spleen-shielded animals, and the fact that heterologous tissue (*i.e.*, rat to mouse) effectively enhances the survival of irradiated mice, the humoral theory seems the most reasonable.

950 East 59th St.
Chicago 37, Illinois

REFERENCES

1. Bacq, Z. M., Dechamps, G., Fischer, P., Herve, A., Le Bihan, H., Lecomte, J., Pirotte, M., and Rayet, P. Protection against x-rays and therapy of radiation sickness with β-mercaptoethylamine. *Science*, 1953, *117*, 633–636.
2. Bacq, Z. M., Herve, A., Lecomte, J., and Fischer, P. Cyanide protection against x-irradiation. *Science*, 1950, *111*, 356–357.
3. Barron, E. S. G., Dickman, S., Muntz, J. A., and Singer, T. P. Studies on mechanism of action of ionizing radiations. I. Inhibition of enzymes by X-rays. *J. Gen. Physiol.*, 1949, *32*, 537–552.
4. Bethard, W. F., Simmons, E. L., and Jacobson, L. O. Preliminary observations on enhanced survival in X-irradiated mice following combined treatment with cysteine, estrogen and spleen protection. USAEC Report, ANL-4625, 1951, pp. 48–49.
5. Bloom, W., and Jacobson, L. O. Some hematological effects of irradiation. *Blood*, 1948, *3*, 586–592.
6. Cole, L. J., Fishler, M. C., and Bond, V. P. Subcellular fractionation of mouse spleen radiation protection activity. *Fed. Proc.*, 1953, *12*, 27.
7. Cole, L. J., Fishler, M. C., Ellis, Marie E., and Bond, V. P. Protection of mice against X-irradiation by spleen homogenates administered after exposure. *Proc. Soc. Exper. Biol. & Med.*, 1952, *80*, 112–117.
8. Congdon, C. C., and Lorenz, E. Humoral factor in irradiation protection: Modification of lethal irradiation injury in mice by injection of rat bone marrow. *Am. J. Physiol.* In press.
9. Cronkite, E. P., Brecher, G., and Chapman, W. H. Mechanism of protective action of glutathione against whole body irradiation. *Proc. Soc. Exper. Biol. & Med.*, 1951, *76*, 396–398.
10. Dowdy, A. H., Bennett, L. R., and Chastain, Sarah M. Protective action of anoxic anoxia against total body roentgen irradiation of mammals. *Radiology*, 1950, *55*, 879–885.
11. Hektoen, L. Influence of x-ray on production of antibodies. *J. Infect. Dis.*, 1915, *17*, 415–422.
12. Hektoen, L. Further studies on effects of roentgen ray and antibody production. *J. Infect. Dis.*, 1918, *22*, 28–33.
13. Henshaw, P. S., Riley, E. F., and Stapleton,

G. E. Biologic effects of pile radiations. *Radiology*, 1947, *49*, 349–360.

14. Jacobson, L. O. Evidence for humoral factor (or factors) concerned in recovery from radiation injury; review. *Cancer Res.*, 1952, *12*, 315–325.
15. Jacobson, L. O., Marks, E. K., and Gaston, E. O. Unpublished data.
16. Jacobson, L. O., Marks, E. K., Gaston, E. O., Robson, M. J., and Simmons, E. L. Spleen shielding and allied studies. USAEC Report, ANL-4625, 1951, p. 44.
17. Jacobson, L. O., Marks, E. K., Gaston, E. O., Robson, M. J., and Zirkle, R. E. Role of spleen in radiation injury. *Proc. Soc. Exper. Biol. & Med.*, 1949, *70*, 740–742.
18. Jacobson, L. O., Marks, E. K., Gaston, E. O., and Simmons, E. L. Studies on the Modification of Radiation Injury. CIBA Foundation Symposium on Experimental Leukaemias, London, November, 1953. In press.
19. Jacobson, L. O., Marks, E. K., and Lorenz, E. Hematological effects of ionizing radiations. *Radiology*, 1949, *52*, 371–395.
20. Jacobson, L. O., Marks, E. K., Simmons, E. L., Hagen, C. W., and Zirkle, R. E. Effects of X Rays on Rabbits. Part II. The Hematological Effects of Total Body X Irradiation on the Rabbit. Zirkle, R. E., Editor. McGraw-Hill Book Company, New York. In press.
21. Jacobson, L. O., and Robson, M. J. Factors effecting x-ray inhibition of antibody formation. *J. Lab. & Clin. Med.*, 1952, *39*, 169–175.
22. Jacobson, L. O., and Robson, M. J. Unpublished data.
23. Jacobson, L. O., Robson, M. J., and Marks, E. K. Effect of x radiation on antibody formation. *Proc. Soc. Exper. Biol. & Med.*, 1950, *75*, 145–152.
24. Jacobson, L. O., Simmons, E. L., and Block, M. Effect of splenectomy on toxicity of Sr^{89} to hematopoietic system of mice. *J. Lab. & Clin. Med.*, 1949, *34*, 1640–1655.
25. Jacobson, L. O., Simmons, E. L., Marks, E. K., and Eldredge, J. H. Recovery from radiation injury. *Science*, 1951, *113*, 510–511.
26. Jacobson, L. O., Simmons, E. L., Marks, E. K., Gaston, E. O., Robson, M. J., and Eldredge, J. H. Further studies on recovery from radiation injury and recovery. *J. Lab. & Clin. Med.*, 1951, *37*, 683–697.
27. Lawrence, J. H., and Lawrence, E. O. Biological action of neutron rays. *Proc. Nat. Acad. Sc.*, 1936, *22*, 124–133.
28. Lorenz, E., Congdon, C. C., and Uphoff, D. Modification of acute irradiation injury in mice and guinea-pigs by bone marrow injections. *Radiology*, 1952, 58, 863–877.
29. Lorenz, E., Heston, W. E., Deringer, M. K., and Eschenbrenner, A. B. Increase in incidence of lung tumors in strain A mice following long-continued irradiation with gamma rays. *J. Nat. Cancer Inst.*, 1946, *6*, 349–353.
30. Lorenz, E., Uphoff, D., Reid, T. R., and Shelton, E. Modification of irradiation injury in mice and guinea pigs by bone marrow injection. *J. Nat. Cancer Inst.*, 1951, *12*, 197–201.
31. Miller, C. P., Hammond, C. W., Tompkins, M., and Shorter, G. Treatment of post-irradiation infection with antibiotics; experimental study on mice. *J. Lab. & Clin. Med.*, 1952, *39*, 462–479.
32. Minot, G. R., and Spurling, R. G. Effect on blood of irradiation, especially short wave length roentgen-ray therapy. *Am. J. M. Sc.*, 1924, *168*, 215–241.
33. Patt, H. M. Protective mechanisms in ionizing radiation injury. *Physiol. Rev.*, 1953, *33*, 35–76.
34. Patt, H. M., Tyree, E. B., Straube, R. L., and Smith, D. E. Cysteine protection against X irradiation. *Science*, 1949, *110*, 213–214.
35. Rekers, P. E., Coulter, M. P., and Warren, S. L. Effect of transplantation of bone marrow into irradiated animals. *Arch. Surg.*, 1950, *60*, 635–667.
36. Rugh, R., and Wang, S. C. Protection against radiation lethality; effect of β-mercaptoethylamine. *Proc. Soc. Exper. Biol. & Med.*, 1953, *83*, 411–414.
37. Simmons, E. L., Jacobson, L. O., and Marks, E. K. Effect of pre-injection of estradiol benzoate plus spleen-shielding on survival of mice following X-irradiation. USAEC Report, ANL-4571, 1951, p. 36.
38. Storer, J. B., Lushbaugh, C. C., and Furchner, J. E. Protective effect of shielded ectopic bone marrow against total body x-radiation. *J. Lab. & Clin. Med.*, 1952, *40*, 355–366.
39. Talbot, J. M., and Pinson, E. A. Experimental use of bone marrow in acute radiation injury. *Mil. Surgeon*, 1951, *108*, 412–417.
40. Treadwell, Anne deG., Gardner, W. U., and Lawrence, J. H. Effect of combining estrogen with lethal doses of roentgen-ray in Swiss mice. *Endocrinology*, 1943, *32*, 161–164.
41. Williams, R. B., Jr., and DeLong, R. P. Effect of spleen shielding, glutathione, and para-amniopropiophenone upon recovery of small bowel epithelium of rat following total body x-radiation. *Fed. Proc.*, 1953, *12*, 406.
42. Zirkle, R. E. Components of acute lethal action of slow neutrons. *Radiology*, 1947, *49*, 271–273.

THE ROENTGEN ASPECTS OF FIVE HUNDRED CASES OF PULMONARY COCCIDIOIDOMYCOSIS

By J. W. BIRSNER, M.D.*
BAKERSFIELD, CALIFORNIA

THIS series of 500 cases of coccidioidomycosis has been reviewed primarily from a radiologist's standpoint. However, a realization of the protean manifestations of the clinical course and complications of the disease is the responsibility of every physician, since coccidioidomycosis has been identified in regions far removed from the endemic areas.

I have estimated that there are 25,000 to 35,000 new cases of coccidioidomycosis yearly. The sources of these cases are as follows: (1) expanding population by migration into endemic areas; (2) migratory workers; (3) heavy passenger and truck traffic through the endemic areas; (4) constant turnover of troops in desert training camps and reactivation of centers such as Camp Roberts, California. A constant stream of new cases is thus being distributed all over the country out of proportion to physician awareness. In turn, without a vacational and residential history, the lesions frequently create a source of vexation to radiologists.

Since the disease results from contact with dust in over 99 per cent of the cases, the geographical location of the endemic areas is of importance. Southern and central Arizona and southern New Mexico have been reported as endemic areas, but the San Joaquin Valley in southern California has the dubious distinction of being the area of highest incidence of the disease. The valley covers 18,000 square miles, is 450 miles long and is the path of entry from Midwestern States into California. It is rich in agriculture and petroleum and is the inland route linking San Francisco and Los Angeles.

Coccidioidomycosis, as Mackler[5] points out, certainly lacks a predictable natural history. Here is a disease which carrries a morbidity and mortality in both the pulmonary and disseminated phases; a disease which, for all practical purposes, cannot be controlled; a disease for which there is no known definitive treatment.

Clinically, coccidioidomycosis may be classified in three major categories: (1) Asymptomatic primary infection, usually without associated roentgen findings or pulmonary complications. (2) Symptomatic primary infection: This may simulate a mild upper respiratory infection or may be a more severe form of the disease with definite infiltration into the lung parenchyma and is usually accompanied by moderate hilar adenopathy. The residual pulmonary complications are statistically significant in this category. (3) Dissemination: Here the pulmonary roentgen findings vary from a miliary involvement to a complete absence of chest pathology at the time of dissemination. Frequently there is extreme hilar adenopathy with some form of residual fibrosis present.

Despite the fact that there are approximately three hundred publications concerning all phases of coccidioidomycosis, well summarized by Schwarz and Muth,[8] there are still many unanswered problems. National appreciation of the disease has been stimulated in direct proportion to the number of physicians who have migrated or been transferred into endemic areas, frequently into military establishments. Roentgen analyses of coccidioidomycosis appeared in the literature with increasing frequency between 1941 and 1948. Since the end of World War II, a number of papers from various Veterans Hospitals have focused attention on the residual complications of pulmonary coccidioidomycosis.

Jamison[4] (96 cases, Army Air Base) gave

* Radiologist, San Joaquin Hospital and Attending Radiologist, Kern General Hospital.

an excellent classification of his cases as follows: nodular parenchymal lesions, cavities, persistent pneumonitis, adenopathy, effusion, and dissemination. Willett and Weiss[13] (100 cases, Army) emphasized a new endemic area near Banning, California. Other authors presenting publications of merit based on army material are: Smith, Beard and Saito,[10] (274 cases), Colburn[2] (75 cases), Sweigert[11] (77 cases, southern Arizona) and Rakofsky and Knickerbocker[6] (60 cases, southern California and Arizona). The conclusions reached in these publications were essentially identical. Winn and Johnson's[14] analysis (40 cases) was derived from civilian material, as was the work of Carter[1] (92 cases); little has been added to the roentgen analysis of coccidioidomycosis since the work of Carter.

The material analyzed in this paper is from a civilian endemic area for coccidioidomycosis. Approximately 3,000 cases of suspected pulmonary coccidioidomycosis were carefully inspected. Because the area was an endemic one, unusually strict criteria were necessary. No case was included unless the diagnosis was confirmed by complement fixation test and/or microscopic presence of spherules (sputum culture, animal inoculation, operated or autopsy material). Therefore, it is obvious that the material presented here, with the strict criteria for positive diagnosis, involved, as a rule, only the acutely ill patient or one in which a differential diagnosis such as tuberculosis, Hodgkin's disease, carcinoma, lymphosarcoma, Boeck's sarcoid, etc., made complement fixation test and other laboratory procedures necessary.

To facilitate analysis, the 500 cases have been divided into three groups: Pediatric (Table I), Intermediate (Table III), and Geriatric (Table VI). Each group has been discussed separately.

PEDIATRIC GROUP

An extensive search of the literature revealed that a roentgen analysis of pulmonary coccidioidomycosis in children has not been previously reported. One hundred and twenty-four cases from three weeks to thirteen years of age are summarized in some detail in Table I. In this group there were 26 cases of dissemination but only 7 deaths occurred. Thus, in this age group, the entity is evidently a benign condition in white patients and is relatively benign in nonwhite. There were 5 cases of cavitation which ultimately resolved. Figures 1 to 7

TABLE I

PEDIATRIC GROUP (0–13 YEARS)

	Male—(64)				Female—(60)				Total—(124)
	White (27)	Colored (15)	Mexican (9)	Other (2)	White (32)	Colored (13)	Mexican (13)	Other (2)	
Complications									
Fibrosis	0	0	0	0	1	0	1	0	2
Coccidioma	1	0	0	0	0	1	0	0	2
Dissemination: bone	0	11	2	1	1	3	3	0	21
other	2	0	1	0	1	1	0	0	5
Pleural effusion	2	1	0	0	3	0	1	1	8
Bronchiectasis	0	0	0	0	1	0	0	0	1
Cavitation	2	0	1	0	1	0	1	0	5
Confirmation									
Skin test positive	22	7	5	1	22	9	9	1	76
Complement fixation positive	25	9	5	0	16	11	9	1	76
Smear and/or culture positive	1	9	1	1	2	4	3	0	21
Spinal fluid positive	1	0	0	0	0	0	0	0	1
Guinea pig positive	0	2	2	0	1	0	0	0	5
Erythema nodosum and/or multiforme	20	0	3	1	18	1	4	1	48
Marked hilar adenopathy	17	4	1	1	8	3	4	0	38
Tuberculosis and coccidioidomycosis	0	2	1	0	0	2	3	0	8
Deaths	2	2	1	0	1	1	0	0	7

TABLE II

COEXISTING PULMONARY COCCIDIOIDOMYCOSIS AND TUBERCULOSIS
(Pediatric Group)

Case	Age	Sex	Race	Coccidioides Diagnosis Confirmed by	Tuberculosis Diagnosis Confirmed by	Postulated Pathogenesis
1 E.S.	7 mo.	M	Col.	Serology pos.; skin test pos.	a.f.b. from guinea pig	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
2 T.R.	2 yr.	M	Mex.	Serology pos.; skin test pos.	Skin test pos.; gastric lavage and g.p. pos.	Separate areas of pulmonary tissue involvement at different dates
3 E.S.	2	M	Col.	Serology pos.; skin test pos.	Skin test pos.; gastric lavage and g.p. pos.	Tuberculous cavitation in an area of coccidioidal granuloma
4 H.G.	5	F	Mex.	Serology pos.; skin test pos.	Skin test pos.; gastric lavage and g.p. pos.	Tuberculous cavitation in an area of coccidioidal granuloma
5 V.G.	6	F	Mex.	Serology pos.; skin test pos.	Skin test pos.; gastric lavage pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
6 B.D.	9	F	Col.	Serology pos.; skin test pos.	Skin test pos.; gastric culture pos. TB adenitis	Separate areas of pulmonary tissue involvement at different dates
7 O.R.	13	F	Col.	Skin test pos.; serology pos.	Skin test pos.; gastric lavage and g.p. pos.	Separate areas of pulmonary tissue involvement at different dates
8 M.C.	13	F	Mex.	Skin test pos. *C. immitis* in smear and culture erythema nodosum	Smear and culture pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*

illustrate various roentgen manifestations of the disease.

Table II presents the first analysis of coexisting pulmonary coccidioidomycosis and tuberculosis in this age group. All 8 cases were postulated roentgenographically prior to clinical confirmation on the basis of their failure to clear rapidly and the extreme hilar adenopathy out of proportion to that normally seen in pulmonary coccidioidomycosis. The concomitancy of the two diseases apparently fails to affect the morbidity or mortality of either coccidioidomycosis or tuberculosis.

Various authors have agreed that erythema nodosum occurs twice as often in women as in men, although coccidioidomycosis is observed four times as frequently in men as in women. Apparently this concept does not apply to the Pediatric Group, as there was no sex predilection to erythema nodosum or to the disease itself.

A positive skin test is of little significance in an acute illness. If the skin test is positive, it may be due to previous infection; if it is negative, the test may have been initiated too early. It is frequently negative in all dilutions if dissemination has occurred. The skin test is significant if it is first negative and two to three weeks later becomes positive.

Do the above tables and roentgenograms represent the typical coccidioidomycotic picture? No, a skin test survey on several thousand children indicated that over 50 per cent had contracted the disease, in most instances with such minimal symptoms that their parents were not aware of it.

Some points of interest are: (a) Calcification occurs in approximately 80 per cent of the cases and has been noted within three weeks after the initial infection. (b) There was a dearth of cavity formation in acute infections; no case of residual cavity formation was noted. (c) The concept that this disease is most probably tracheobronchial as well as parenchymal is postulated on the basis of endoscopic examinations in the acute phase of coccidioidomycosis in the adult.

INTERMEDIATE GROUP

Three hundred and fifty-two cases, covering ages fourteen through sixty, are tabulated in Table III. Sixteen cases of coexisting pulmonary coccidioidomycosis and tuberculosis in adults are presented in detail in Table IV.

TABLE III

INTERMEDIATE GROUP (14–60 YEARS)

	Male—(216)				Female—(136)				Total—(352)
	White (129)	Colored (47)	Mexican (24)	Other (16)	White (98)	Colored (27)	Mexican (11)	Other (0)	
Complications									
Fibrosis	6	0	2	0	4	0	0	0	12
Coccidioma	6	1	0	0	2	0	0	0	9
Dissemination: bone	4	5	1	3	3	5	0	0	21
other	4	15	2	7	8	8	2	0	46
Pleural effusion	18	7	6	2	3	1	2	0	39
Bronchiectasis	3	0	1	0	3	0	0	0	7
Cavitation	28	4	3	0	19	0	0	0	54
Confirmation									
Skin test positive	58	23	15	7	59	12	6	0	180
Complement fixation test positive	104	39	20	13	70	22	7	0	275
Smear and/or culture positive	12	6	0	5	7	4	0	0	34
Spinal fluid positive	5	2	1	2	0	2	0	0	12
Guinea pig positive	9	3	1	2	1	0	0	0	16
Sputum positive	8	5	1	1	3	0	1	0	19
Erythema nodosum and/or multiforme	19	4	4	0	39	2	4	0	72
Marked hilar adenopathy	39	9	4	3	23	3	0	0	81
Tuberculosis and coccidioidomycosis	5	2	0	1	6	2	0	0	16
Deaths	6	14	2	6	3	11	2	0	44

Coccidioidomycosis is tracheobronchial as well as parenchymal. Endoscopic examinations, as reported by Cotton and Birsner,[3] revealed coccidioidal infection to be primarily bronchial in its initiation. The sequence of events would seem to be hyperemia and reddening throughout the bronchi adjacent to the pulmonary infiltration; this progresses to a submucosal type of infiltration with edema. The infection may go to this phase and then start clearing. In other cases, areas of ulceration may be found; the ulcerations appear to be widespread, and

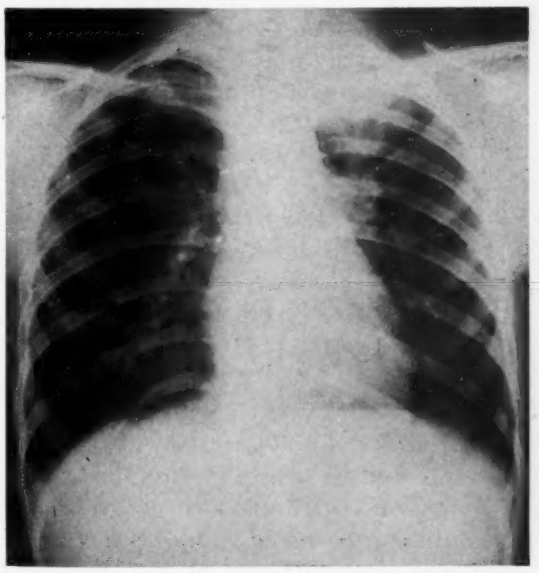


FIG. 1. Hilar adenopathy and pulmonary infiltration.

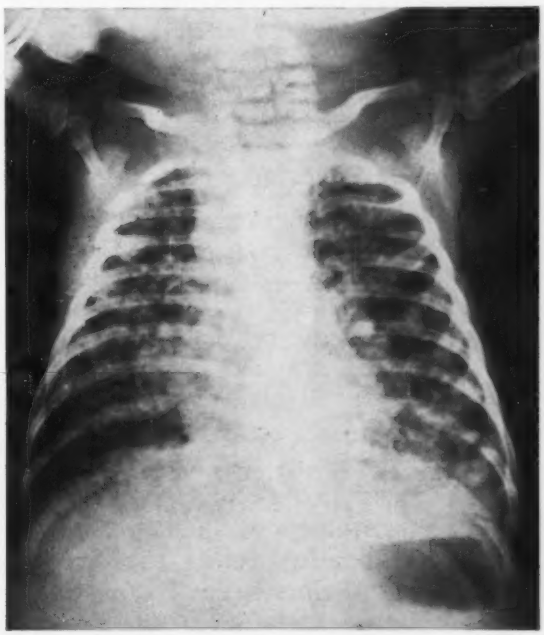


FIG. 2. Acute miliary spread in three week old white female infant; death in six weeks.

TABLE IV

COEXISTING PULMONARY COCCIDIOIDOMYCOSIS AND TUBERCULOSIS
(Intermediate Group)

Case	Age	Sex	Race	Coccidioides Diagnosis Confirmed by	Tuberculosis Diagnosis Confirmed by	Postulated Pathogenesis
1 A.J.	22	F	W	Skin test pos.; serology pos.	Gastric lavage pos.	Coccidioidal cavitation or infection in an area of dormant tuberculosis
2 D.R.	24	F	W	Skin test pos.; serology pos.	Sputum pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
3 F.C.	25	M	W	Serology pos.	Sputum pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
4 E.C.	29	M	Mex.	Sputum pos.	Clinical and roentgen proof of TB prior to cocc. in contralateral lung	Separate areas of pulmonary tissue involvement at different dates
5 J.M.	31	M	W	Skin test pos.; serology pos.; sputum pos.	Sputum pos.	Separate areas of pulmonary tissue involvement at different dates
6 F.T.	32	F	W	Serology pos.; sputum pos.	Sputum pos.	Coccidioidal cavity with secondary infection by *Mycobacterium tuberculosis*
7 J.A.	34	M	W	Spherules in surg. specimen; cult. and specimen pos. fungus	Sputum pos.	Coccidioidal cavity with secondary infection by *Mycobacterium tuberculosis*
8 G.J.	35	F	W	Skin test pos.; sputum pos.; surgical specimen pos.	Surgical specimen pos.; guinea pig pos.	Coccidioidal cavity with secondary infection by *Mycobacterium tuberculosis*
9 J.M.	37	M	Mex.	Skin test pos.; serology pos.	Skin test pos.; smear and culture pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
10 B.C.	38	F	W	Skin test pos.; serology pos.	Sputum pos.; cervical gland biopsy pos.	Coccidioidal cavity with secondary infection by *Mycobacterium tuberculosis*
11 D.V.	43	M	W	Skin test pos.; cult. from bronchus pos. g.p. pos.	Skin test pos.; gastric lavage pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
12 I.U.	45	F	W	Skin test pos.; spherules in surgical spec.	Skin test pos.; surgical spec. pos.	Tuberculous cavitation in an area of coccidioidal granuloma
13 M.R.	45	M	Fil.	Skin test pos.; serology pos.	Skin test pos.; sputum pos.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
14 R.B.	50	M	W	Sputum pos., confirmed by g.p.	Sputum pos., confirmed by g.p.	Simultaneous infection with *Mycobacterium tuberculosis* and *Coccidioides immitis*
15 M.H.	50	F	W	Skin test pos.; serology pos.	Skin test pos.; sputum pos.; micro. pos.	Coccidioidal cavitation or infection in an area of dormant tuberculosis
16 E.G.	62	F	W	Surgical spec. pos.	Pos. sputum TB empyema	Coccidioidal cavitation or infection in an area of dormant tuberculosis

pinpoint ulcerations may occur. In a very few instances, granulation tissue may be seen. This clears rapidly with the subsiding acute infection.

The complications of pulmonary coccidioidomycosis are: (1) fibrosis of varying degrees of parenchymal infiltration; (2) coccidioma; (3) dissemination; (4) pleural effusion; (5) bronchiectasis; (6) cavitation.

It is almost impossible to establish the coccidioidal origin of fibrosis, coccidioma or bronchiectasis unless adequate laboratory data were obtained during the symptomatic period of the disease. I cannot help but feel that this accounts for the fact that in Table III we were able to prove beyond a doubt only 12 instances of residual fibrosis, 9 cases of coccidioma, and bronchiectasis a total of 7 times. Actually, in this area of the San Joaquin Valley, it is unusual to see a completely normal roentgenogram of the chest in an adult.

Figures 8 to 21 illustrate the complexity of the disease and the protean manifestations. Figures 22 to 26 are roentgenograms of local physicians who contracted the disease from six weeks to seventeen years after migrating to this endemic area.

The complications that occurred following erythema nodosum were thought to be of sufficient interest to present in tabular form. Table V is presented to illustrate the fallacy of the prevalent idea that no serious complications will ensue if the patient is fortunate enough to have "the bumps" along with his "valley fever."

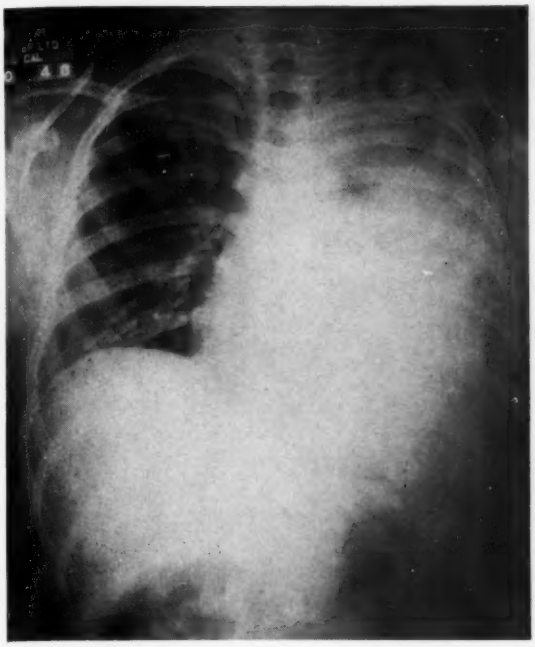


FIG. 3. Marked effusion, left hemithorax.

Schwarz and Muth[8] stated in their review that only 2 cases of erythema nodosum have been previously reported in colored patients; on examination of Tables I and III it will be noted that the existence of erythema nodosum was established in 7 colored patients.

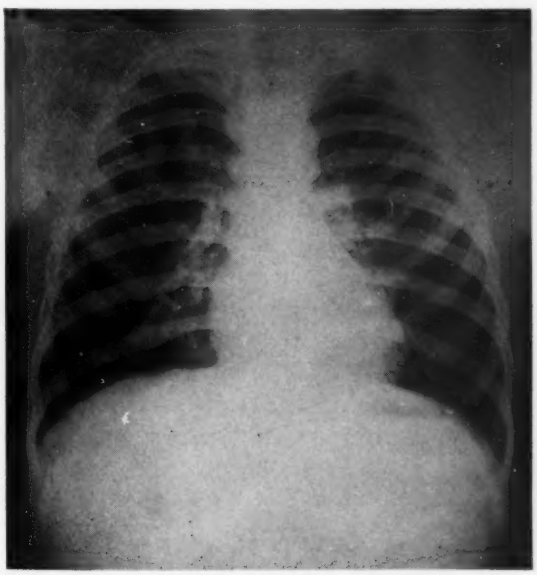


FIG. 4. Coccidioma, left costophrenic angle.

FIG. 5. Coexisting disseminated coccidioidomycosis and tuberculosis. Note osteolytic lesion in the right ninth rib.

CASE REPORTS

CASE I. A.F., white female, aged thirty-three, a Public Health nurse, had a primary infection in 1947 associated with fever, cough, malaise

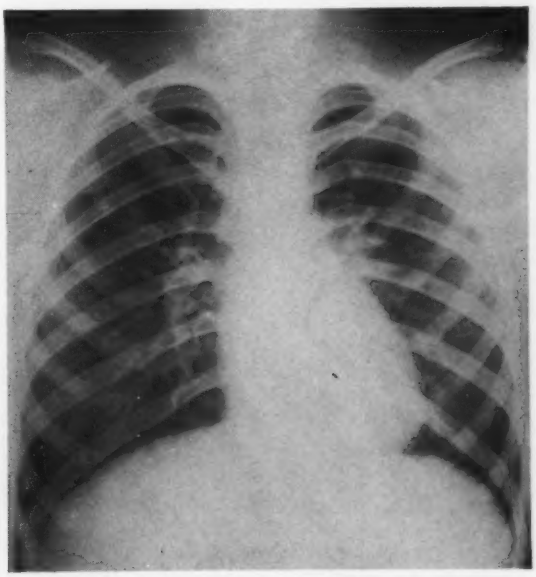


FIG. 6. Residual hilar adenopathy three months after original infiltrative process.

TABLE V

ERYTHEMA NODOSUM FOLLOWED BY COMPLICATIONS

Case	Age	Sex	Race	Complication
1 K.S.	16	F	W	Coccidioidal cavity right chest
2 E.M.	27	F	W	Coccidioidal cavity left chest
3 W.J.	28	F	W	Coccidioidal cavity right upper lobe
4 M.A.	42	F	W	Coccidioidal cavity left upper lobe
				ERYTHEMA NODOSUM FOLLOWED BY DISSEMINATION
1 B.V.	20	F	Mex.	Died of coccidioidal meningitis
2 S.A.	31	M	Col.	Coccidioidal skin lesions proved by biopsy and culture
3 E.L.	31	M	Col.	Granulomatous skin lesions, lymphadenopathy and subcutaneous nodules. Died 6 weeks after onset, steadily retrogressive course
4 M.G.	45	F	W	Coccidioidal skin lesions, proved by biopsy

and infiltration in the right mid-lung field. Diagnosis of coccidioidomycosis was made by skin test and complement fixation test. The patient remained asymptomatic after the primary infection had subsided. Serial films from 1950 to 1952 revealed a coccidioma which cavitated, refilled and recavitated; then the cavity underwent expansion (Fig. 28 to 34). The complement fixation test remained negative during all phases of this process. The changes noted

FIG. 7. Wedge-shaped density, left third anterior interspace; primary symptomatic coccidioidomycosis.

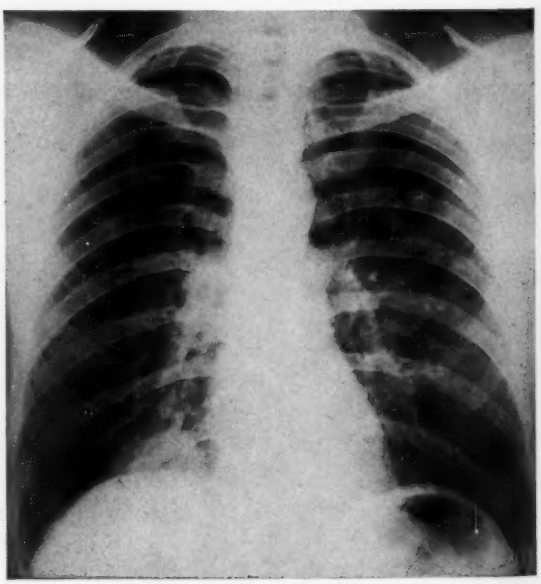


FIG. 8. Statistically frequent; note hilar adenopathy and infiltration in dorsal division of lower lobe.

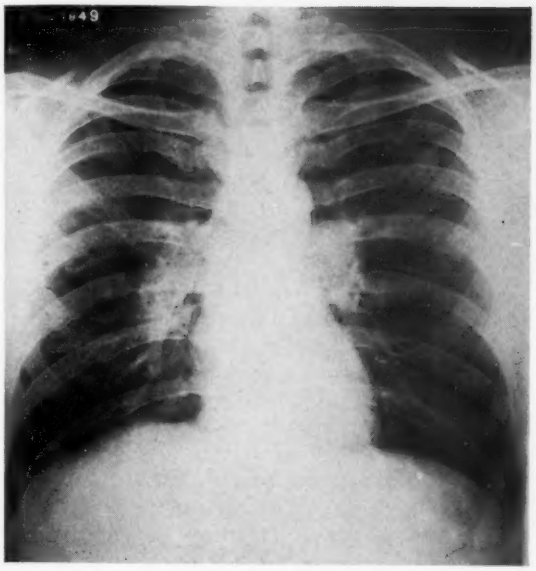


Fig. 9. Bilateral hilar adenopathy with infiltration into left second anterior interspace.

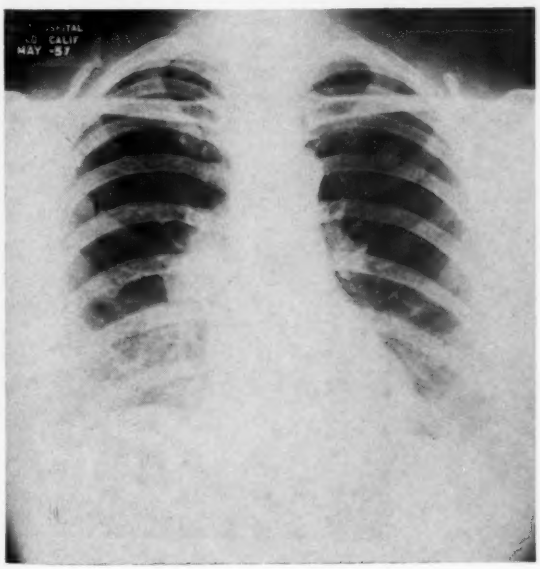


Fig. 10. Hilar adenopathy

Fig. 11. Residual fibrosis and bronchiectasis.

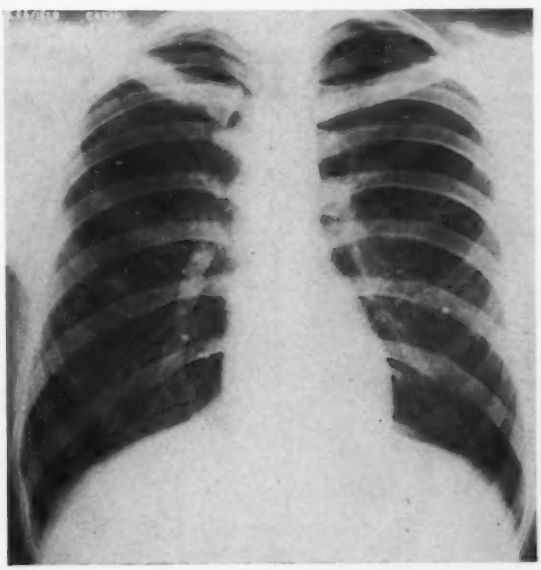


Fig. 12. Multiple coccidioma.

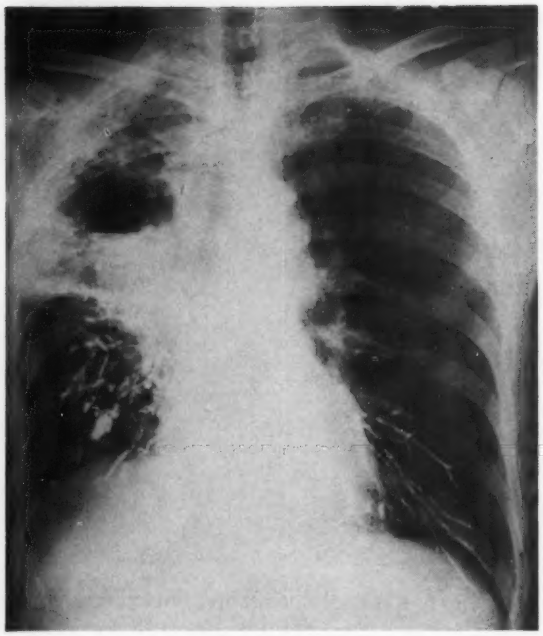


FIG. 13. Coccidioidal cavitation, associated fibrosis and bronchiectasis.

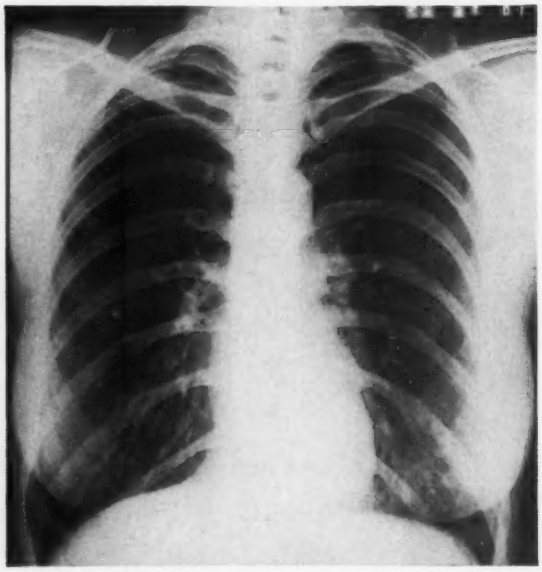


FIG. 14. Thin-walled cavity left second anterior interspace; most frequently recognized residual coccidioidal cavity.

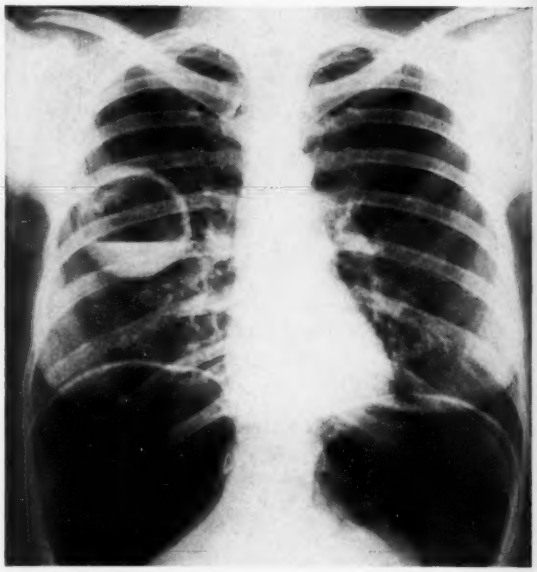


FIG. 15. Large cavity with fluid level; pneumoperitoneum unsuccessful; later, surgery.

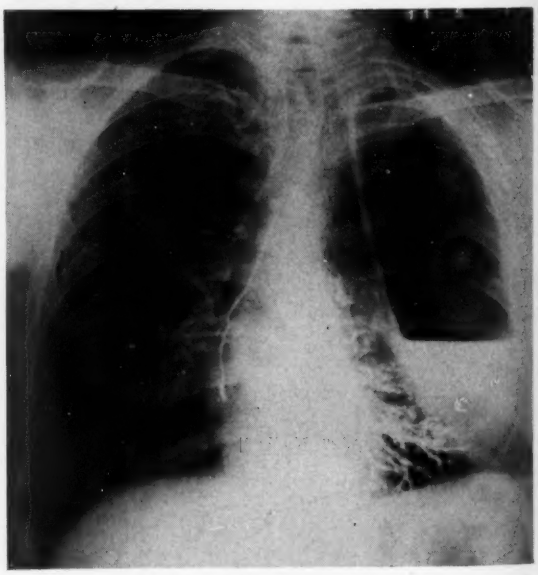


FIG. 16. Residual secondarily infected cavity with fluid level.

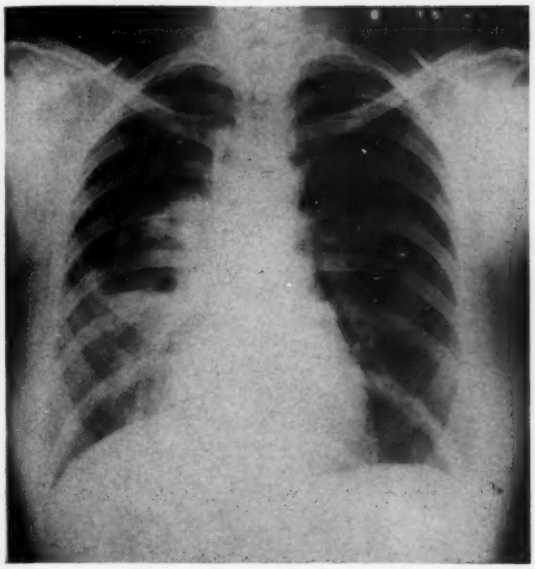


Fig. 17. Large secondarily infected cavity.

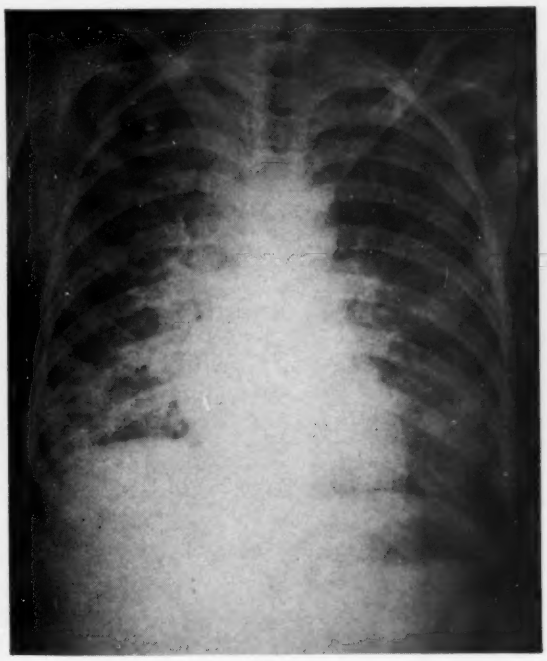


Fig. 18. Miliary spread.

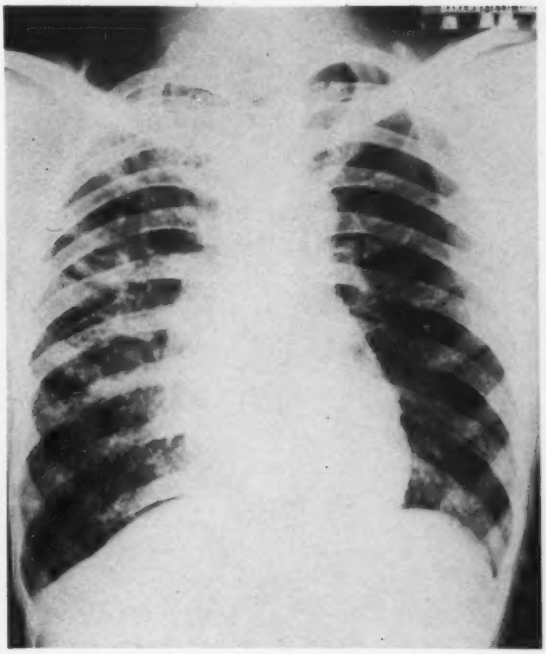


Fig. 19. Coexisting pulmonary coccidioidomycosis and tuberculosis.

Fig. 20. Associated carcinoma and coccidioidal cavity, confirmed by pneumonectomy.

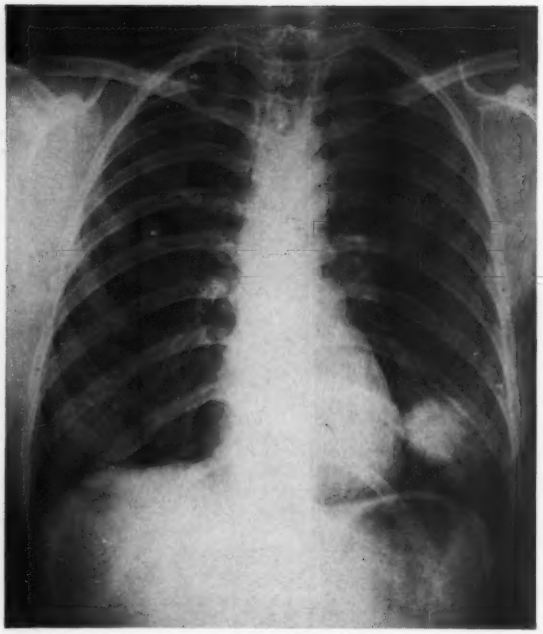


Fig. 21. Large coccidioma.

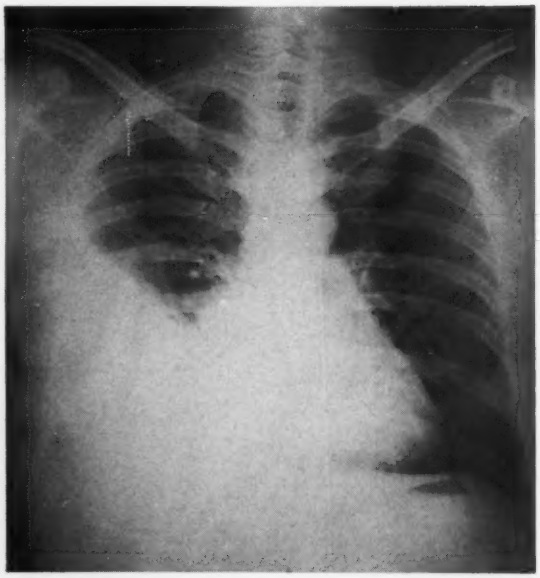


Fig. 22. Effusion. Local physician in endemic area fifteen months.

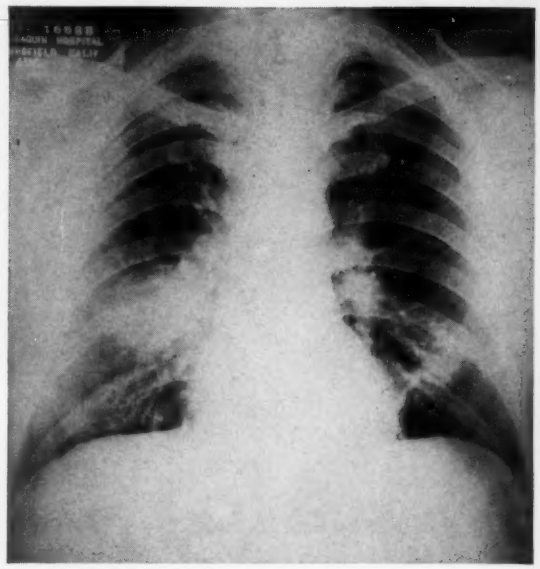


Fig. 23. Bilateral infiltration. Local physician in endemic area seven years.

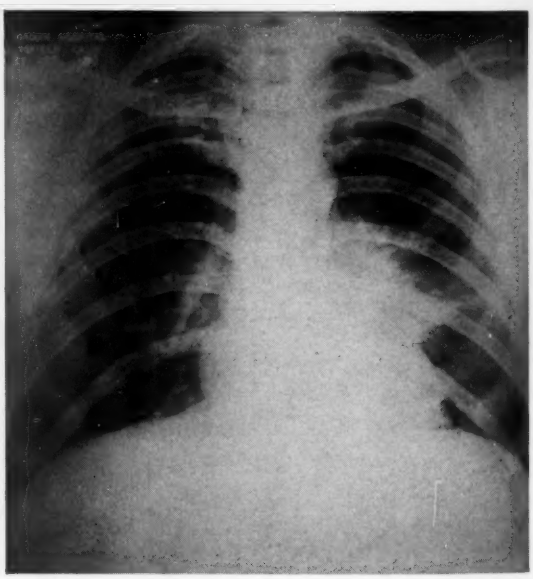


Fig. 24. Hilar adenopathy and infiltration. Local physician in endemic area seventeen years.

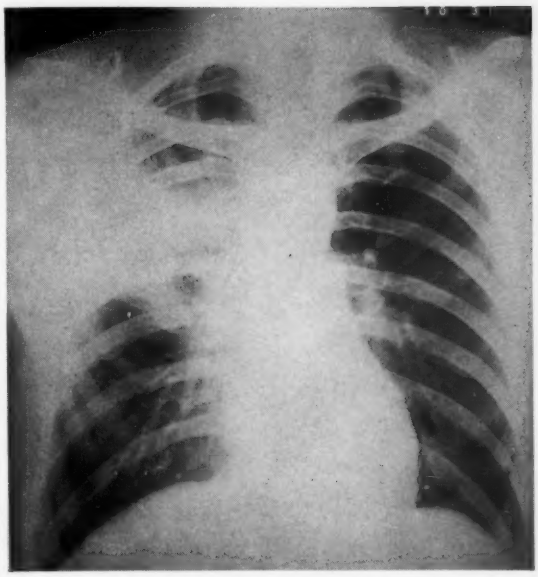


Fig. 25. Right upper lobe involvement. Local physician in endemic area five months.

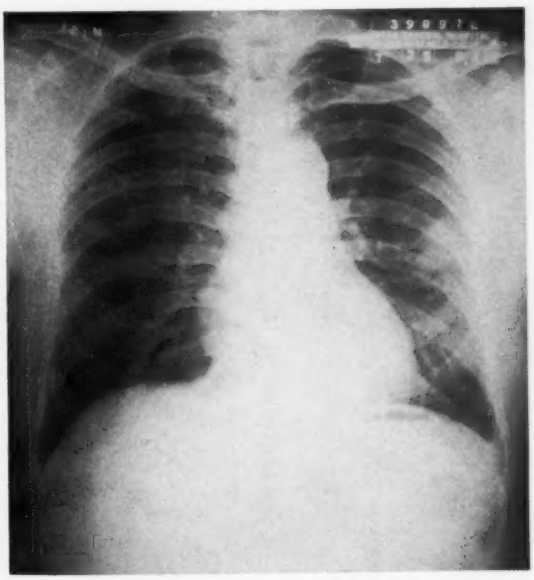


Fig. 26. Hilar adenopathy with infiltration. Local physician in endemic area six weeks.

Fig. 27. Primary carcinoma of lung. Misdiagnosed by author as "shelling-out coccidioma" (note resemblance).

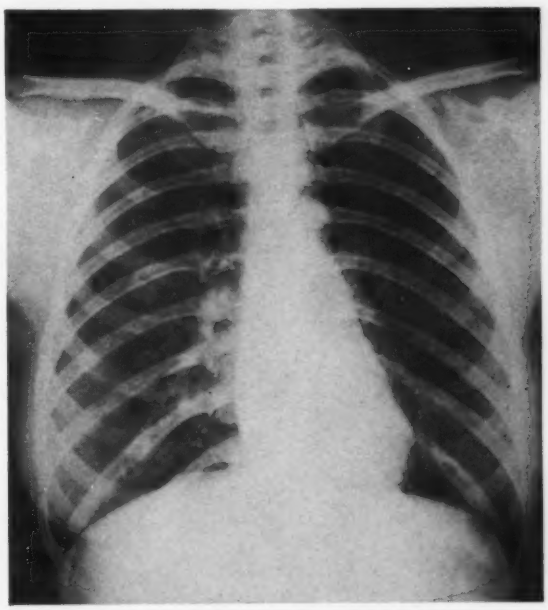


Fig. 28. Case 1. A. F. Coccidioma, right mid-lung field.

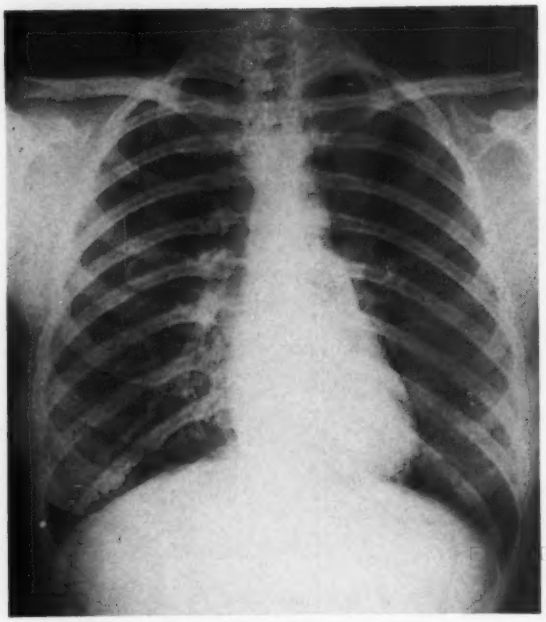


Fig. 29. Case 1. A.F. Coccidioma cavitated.

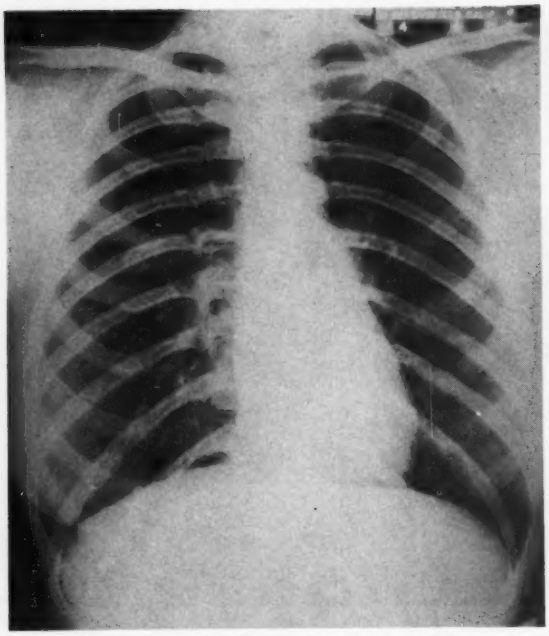


Fig. 30. Case 1. A.F. Coccidioma refilled.

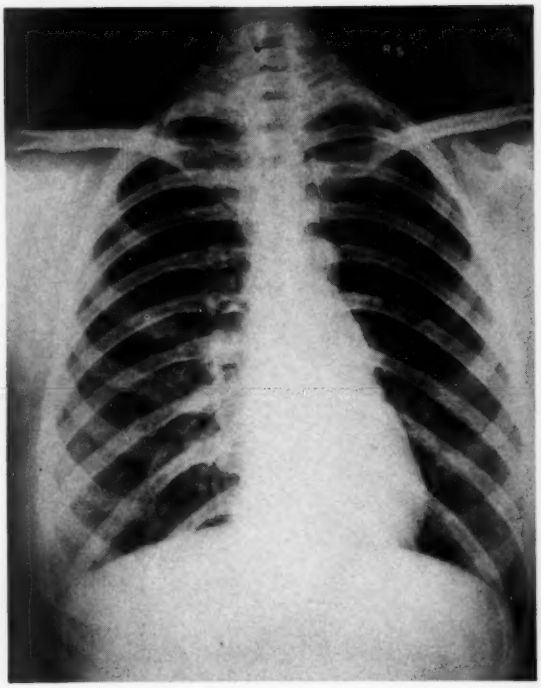


Fig. 31. Case 1. A.F. Coccidioma recavitated.

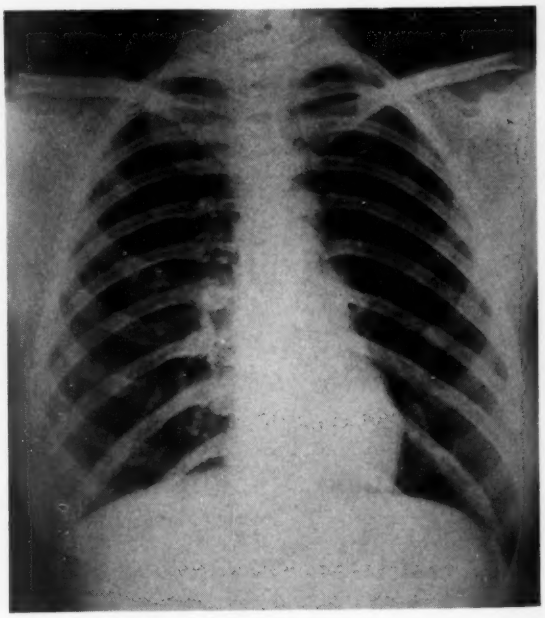


Fig. 32

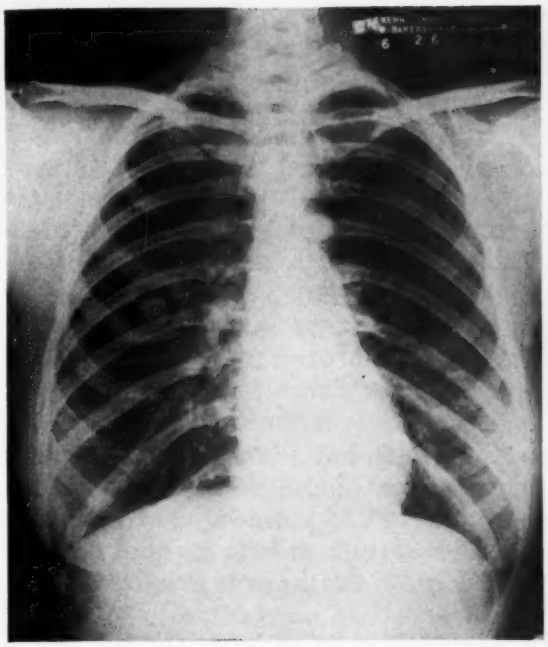


Fig. 33

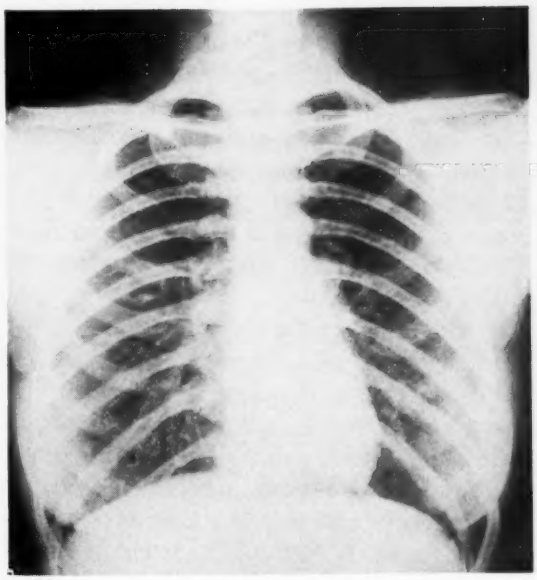


Fig. 34

Fig. 32, 33 and 34. Case 1. A.F.
Cavity enlarging.

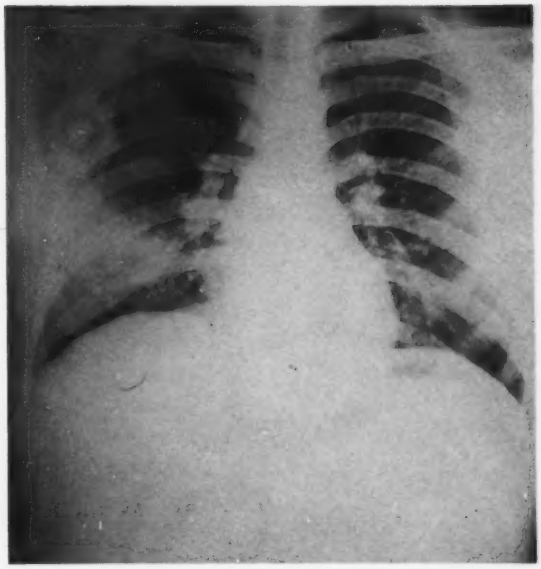


Fig. 35. Case 2. P.P. Infiltrative process right middle lobe.

Fig. 36. Case 2. P.P. Lateral view of chest to demonstrate location of process.

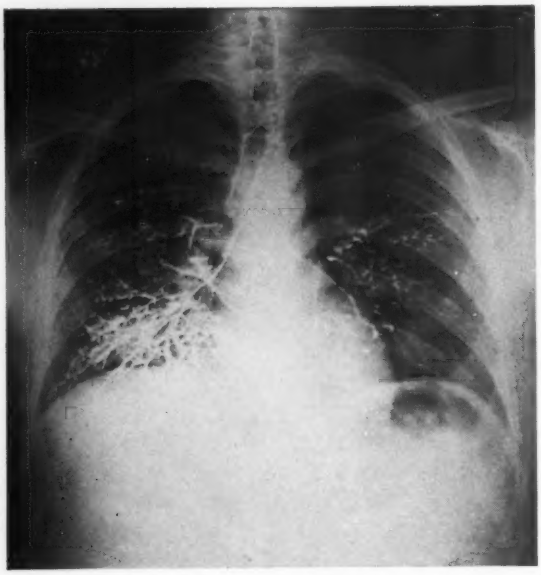


FIG. 37. Case 2. P.P. Bronchogram demonstrates residual fibrosis.

in the roentgenograms were attributed to secondary infection of the cavity with subsequent bronchial obstruction. The cavity was removed surgically and the diagnosis was further confirmed by the presence of spherules in the surgical specimen.

CASE 2. P.P., male Mexican, aged thirty-three, an agricultural worker, had an acute primary infection with fever, cough, pain in the chest, and an infiltrative process involving the middle lobe of the right lung with bilateral hilar adenopathy. The roentgen diagnosis of coccidioidomycosis was confirmed by skin test and complement fixation test. Figures 35 and 36 show residual inflammatory process; Figure 37 demonstrates residual fibrosis in the middle lobe of the right lung twelve weeks after onset of the disease.

GERIATRIC GROUP

The pertinent observations in patients over sixty years of age are presented in Table VI. Although the number is small, the conclusions reached here would certainly indicate that an analysis of a larger series is warranted.

It is rather difficult to account for the high morbidity and mortality encountered in this group, but a low index of suspicion may be a contributing factor. However, the benignity of coccidioidomycosis loses considerable stature with 10 cases of dissemination and 6 deaths in a series of only 24 cases.

The problem of differentiating the complications of coccidioidomycosis from bronchogenic carcinoma cannot be overemphasized. Figure 27 is that of a sixty-two year

TABLE VI

GERIATRIC GROUP (OVER 60 YEARS)

	Male—(12)				Female—(12)				Total—(24)
	White (6)	Colored (4)	Mexican (2)	Other (0)	White (8)	Colored (3)	Mexican (0)	Other (1)	
Complications									
Fibrosis	1	0	0	0	0	1	0	0	2
Coccidioma	0	0	0	0	0	0	0	0	0
Dissemination: bone	0	0	1	0	1	1	0	1	4
other	4	2	0	0	0	0	0	0	6
Pleural effusion	1	1	0	0	0	0	0	0	2
Bronchiectasis	0	0	0	0	0	0	0	0	0
Cavitation	0	0	2	0	0	0	0	0	2
Confirmation									
Skin test positive	3	2	0	0	3	1	—	—	9
Complement fixation positive	4	1	1	0	6	2	0	0	14
Smear and/or culture positive	1	1	0	0	1	1	0	1	5
Spinal fluid positive	0	0	0	0	0	0	0	0	0
Sputum positive	1	0	0	0	0	0	0	0	1
Erythema nodosum and/or multiforme	0	0	0	0	2	0	0	0	2
Marked hilar adenopathy	0	0	0	0	2	0	0	0	2
Tuberculosis and coccidioidomycosis	0	0	0	0	1	0	0	0	1
Deaths	3	1	0	0	1	1	0	0	6

old white male who had been confined to a nursing home for eighteen months because of senile changes. At the time of this roentgenogram, neurological signs and symptoms pointed to a space-consuming cranial lesion. The chest roentgenogram was made to rule out primary bronchogenic carcinoma of the lung. Because of the typical appearance of the hollowed-out coccidioma with the minimal hilar adenopathy, I felt certain that this was one of the complications of pulmonary coccidioidomycosis. The pathologist's report on the neurosurgical specimen inferred the tumor was metastatic and was probably that of bronchogenic carcinoma; this was verified at autopsy.

DISCUSSION

Certain problems which exist in an endemic area for coccidioidomycosis are sources of considerable concern to the clinician and to the radiologist. Misdiagnosis is not uncommon. Patients suffering from coccidioidomycosis have been confined to tuberculosis sanatoriums while others who had active tuberculosis were observed for coccidioidomycosis, allowing the tuberculosis to become far advanced.

Other pitfalls are: (1) primary symptomatic coccidioidomycosis masking the existence of coexisting conditions such as tuberculosis, the lymphoma group, subacute bacterial endocarditis and other mycotic diseases; (2) the large number of effusions considered to be of coccidioidal origin without adequate diagnosis or follow-up.

The pulmonary complications that are problems in diagnosis are the persistence of hilar shadow enlargement and the coccidioma. Over 90 per cent of coccidiomas are located more than 5 cm. from the hilar area and their average diameter is 1.3 cm. The largest coccidioma in this series measured 6 cm. in diameter (Fig. 21) and its coccidioidal origin was established by microscopic examination of the surgical specimen.

Bronchogenic carcinoma is frequently extremely difficult to diagnose in this geographic area because of the large number of suspected coccidiomas, the secondarily infected cavities, and the unilateral hilar enlargement. One cannot utilize often enough Rigler's[7] criteria of the significance of unilaterial hilar shadow enlargement in the early diagnosis of carcinoma of the lung.

The low incidence of cavities and coccidiomas positively diagnosed in this series is undoubtedly due to the fact that two-thirds of all coccidioidal cavities and most coccidiomas will give negative serological tests; therefore, absolute confirmation in most cases will be established following surgery or at autopsy. The thin-walled cavity with a minimal zone of reaction is the most easily recognizable of the complications of this disease and has been established in the literature as representing the highest incidence of cavity formation. In this series, however, the secondarily infected cavity with a zone of reaction adjacent to the cavity was the more predominant type of cavity residual.

In this study, miliary spread throughout both lung fields had a high incidence of dissemination. In the majority of cases the dissemination occurred while the miliary process could still be identified roentgenographically. In 3 instances the miliary spread completely cleared two to three months before the patients were readmitted to the hospital with signs and symptoms of coccidioidal meningitis. It is not unusual to see patients with coccidioidal meningitis whose chest roentgenograms are normal except for hilar enlargement. No case of meningitis was noted where there was residual cavitation.

In all of our cases of dissemination, the process occurred within nine months after the initial symptoms, the average being three to five months. Except for the relation between miliary spread and dissemination, the degree of pulmonary involvement and the incidence of pulmonary complications apparently have no correlation with dissemination predictions.

Tables II and IV were limited strictly to coexisting *pulmonary* coccidioidomycosis

and tuberculosis. The unaccountable racial differences that exist in Table II as compared to Table IV were of considerable surprise. No explanation can be given as to why the coexisting diseases were limited entirely to nonwhite patients in the Pediatric Group and primarily to white patients in the Intermediate Group. A review of the literature revealed only 6 isolated case reports (all adult males) of coexisting pulmonary coccidioidomycosis and tuberculosis.

Several of the cases presented in this series were examples of coccidioidomycosis during pregnancy and some of the recorded deaths were maternal deaths. Reference is made to the work of Smale and Birsner[9] and Vaughan and Ramirez,[12] which should encourage further study.

Complement fixation results furnished by Dr. C. E. Smith have been invaluable to physicians in this area and have been instrumental in making this study possible. A great deal of our current and future knowledge will be based on his work and the availability of his complement fixation test.

Since there is no known treatment for primary coccidioidomycosis, during the acute phase of the disease a course of antibiotic therapy is recommended for two reasons: (1) because of the length of time necessary to establish the diagnosis; and (2) the possibility of invasion of the tracheobronchial lining by pathogens already present. In the treatment of residual pulmonary complications, if the pathological defect is such that thoracic surgery is warranted, the etiological agent, *Coccidioides immitis*, should not be a deterrent factor. When pleural effusion occurs, thoracentesis is indicated and should be repeated if necessary to prevent a resultant nonexpansile lung or lobe of the lung.

Some misconceptions will be avoided and increased information gathered when the complement fixation test can be performed quickly on a local level. This test has recently been released to Kern General Hospital and undoubtedly will soon be available locally to all physicians. The unavoidable ten to fourteen day delay in securing the reports will be eliminated and specimens will no longer be "ruined in transit." Furthermore, local test availability will remove the temptation of substituting fantasy for fact on the data sheet accompanying the serological specimen.

Even the most classic case of coccidioidomycosis warrants confirmation since there is no way to prognosticate which patients will develop pulmonary complications or dissemination. Confidence in clinical judgment and failure to confirm will also hamper the search for coexisting disease which most certainly should be initiated after six to eight weeks if the patient is not responding clinically with concomitant resolving roentgen changes.

The responsibility of accurately diagnosing this disease certainly lies within the province of the medical profession. However, industry, labor unions and chambers of commerce should be more aware of the problem and cooperate to control dust hazards and to establish funds for research. They should have a program of accurate, factual orientation for newcomers into endemic areas where there is unquestioned exposure to the disease with its numerous complications. If new arrivals in the endemic area were urged to have a base line skin test and chest roentgenogram and rechecks at yearly intervals, the problem of identifying certain residual lesions as coccidioidomycosis would certainly be simplified and bronchogenic carcinoma would be more easily diagnosed.

Personnel in the endemic areas are undergoing an occupational hazard. Yet there has apparently been a neglect and hesitancy to identify this disease as one warranting industrial compensation. Since so many workers are brought to these areas, there should be some clear-cut criteria for compensation if the disease is contracted.

A national headquarters where all cases of proved coccidioidomycosis could be listed with tabulation of their clinical histories and pathological material would, over a period of years, certainly bring re-

sults through further research into all phases of this disease.

SUMMARY

A series of five hundred cases of pulmonary coccidioidomycosis in a civilian area were reviewed. Strict criteria for diagnosis were observed.

The cases were divided into Pediatric, Intermediate and Geriatric Groups, covering an age range from three weeks to seventy-seven years.

Twenty-four cases of coexisting pulmonary coccidioidomycosis and tuberculosis have been presented and a postulated pathogenesis is offered.

Eight instances of erythema nodosum followed by complications and/or dissemination have been listed.

The following points were stressed:

1. Tracheobronchial findings in primary symptomatic pulmonary coccidioidomycosis.

2. Misdiagnosis, both in the primary symptomatic phase of the disease and in its protean manifestations.

3. The masking of coexisting diseases by primary symptomatic coccidioidomycosis.

4. The difficulty in differentiating the complications of coccidioidomycosis from bronchogenic carcinoma.

5. The need for positive confirmation in all cases of suspected coccidioidomycosis and the corollary that any case of erythema nodosum with or without associated pulmonary hillar adenopathy should be checked for possible coccidioidal origin.

6. Coccidioidomycosis as an occupational hazard in an endemic area.

San Joaquin Hospital
2628 Eye Street
Bakersfield, Calif.

REFERENCES

1. Carter, R. A. Roentgen diagnosis of fungous infections of lungs with special references to coccidioidomycosis. *Radiology*, 1942, *38*, 649–659.
2. Colburn, J. R. Roentgenological types of pulmonary lesions in primary coccidioidomycosis. Am. J. Roentgenol. & Rad. Therapy, 1944, *51*, 1–8.
3. Cotton, B. H., and Birsner, J. W. Endoscopic examinations in acute and chronic pulmonary coccidioidomycosis. Unpublished.
4. Jamison, H. W. Roentgen study of chronic pulmonary coccidioidomycosis. Am. J. Roentgenol. & Rad. Therapy, 1946, *55*, 396–412.
5. Mackler, Helen. Coccidioidomycosis, disease with "natural history." *J. Am. M. Women's A.*, 1951, No. 9, *6*, 341–344.
6. Rakofsky, M., and Knickerbocker, T. W. Roentgenological manifestations of primary pulmonary coccidioidomycosis. Am. J. Roentgenol. & Rad. Therapy, 1946, *56*, 141–155.
7. Rigler, L. G., O'Loughlin, B. J., and Tucker, R. C. Significance of unilateral enlargement of hilus shadow in early diagnosis of carcinoma of lung. *Radiology*, 1952, *59*, 683–693.
8. Schwarz, J., and Muth, J. Coccidiomycosis: review. *Am. J. M. Sc.*, 1951, *221*, 89–107.
9. Smale, L. E., and Birsner, J. W. Maternal deaths from coccidioidomycosis. *J.A.M.A.*, 1949, *140*, 1152–1154; correction, 1949, *141*, 212.
10. Smith, C. E., Beard, R. R., and Saito, M. T. Pathogenesis of coccidioidomycosis with special reference to pulmonary cavitation. *Ann. Int. Med.*, 1948, *29*, 623–655.
11. Sweigert, C. F., Turner, J. W., and Gillespie, J. B. Clinical and roentgenologic aspects of coccidioidomycosis. *Am. J. M. Sc.*, 1946, *212*, 652–673.
12. Vaughan, J. E., and Ramirez, H. Coccidioidomycosis as complication of pregnancy. *California Med.*, 1951, *74*, 121–125.
13. Willett, F. M., and Weiss, A. Coccidioidomycosis in southern California; report of new endemic area with review of 100 cases. *Ann. Int. Med.*, 1945, *23*, 349–375.
14. Winn, W. A., and Johnson, G. H. Primary coccidioidomycosis; roentgenographic study of 40 cases. *Ann. Int. Med.*, 1942, *17*, 407–422.

RENAL ARTERIOGRAPHY*

By ARTHUR T. EVANS, M.D., F.A.C.S.
Department of Urology, College of Medicine, University of Cincinnati and Christ Hospital
CINCINNATI, OHIO

THE visualization of arterial systems has become well accepted as a safe yet valuable procedure for diagnosis and prognosis, and as an indicator of proper therapy in a number of fields of medicine. Visualization of the abdominal aorta and its branches by translumbar puncture has only recently become fully appreciated. Dos Santos,[6] a Portuguese urologist, first utilized the technique in 1929. Nelson[13] and Doss[3] independently but simultaneously reported their experience with the procedure in 1942. Our interest was aroused in the procedure we prefer to call "translumbar arteriography" in 1949, and since that time we have utilized the procedure extensively in evaluating urologic patients. On a number of occasions, in these patients, we have accidentally discovered extrarenal lesions of the vascular system; further, we have utilized the technique to demonstrate suspected aortic and iliac artery lesions.

TECHNIQUE

This simple, safe technique was developed on the following principles: (1) Maximum concentration of contrast medium is the desired effect in the particular area of the arterial system to be studied. Therefore, rapidity of injection and not quantity of injected medium is the important factor, when combined with proper time of roentgen-ray exposure. (2) Simple, error-free, easily obtainable, inexpensive and easily transportable equipment is necessary. (3) The contrast medium utilized must be of low toxicity and present maximum opacity. (Neo-iopax 75 per cent, urokon 70 per cent and diodrast 70 per cent best fulfill these requirements.) (4) Short anesthesia time and lack of patient motion are important.

The patient to be studied is placed in the prone position on the roentgen table. He is tested for iodide sensitivity by the intravenous injection of 0.5 cc. of the selected opaque medium. A plain film is made on a 14 by 17 inch film, centering the exposure over the second lumbar vertebra. The same exposure technique is utilized as in pyelography, except that the kilovolt adjustment is advanced by 10 to 12 kilovolts. The exposure time must be set at 0.1 second, and rotary anodes are required.[7]

While waiting the necessary five minutes for the patient's reaction to the intravenously injected iodide, the initial film is developed. The entire back, from the nipple level to the iliac crest, is surgically cleansed and draped with sterile towels. The initial film is viewed, and any adjustments to exposure technique and positioning are made. After the "sensitivity time" has elapsed and the roentgenographic technique is found to be favorable, the patient is anesthetized with intravenous sodium pentothal. During the anesthetic induction of the patient the operator, using sterile gloves, and a lead apron for roentgen-ray protection, fills a 10 cc. Sana-Lok control syringe with 70 per cent urokon, 75 per cent neo-iopax, or 70 per cent diodrast, whichever he prefers. He then attaches a plastic tube of the type used in commercial intravenous sets, measuring 6–8 inches in length and fitted with a Luer adaptor, to the syringe containing the contrast medium. The tubing is filled with the medium and the air eliminated from the system.[16]

A point, four to five finger-breadths (8 cm.) to the left of the spinous processes just below the twelfth rib, is then located. The twelfth thoracic vertebra is then identified by palpating up the twelfth rib. With the patient adequately anesthetized, a No. 18 gauge, 6 inch needle is inserted superiorly, medially and ventrally to the body of the previously identified twelfth thoracic vertebra, a distance of 3–4 inches. When the resistance of this bony structure is encountered, the needle is withdrawn 1–2 inches, and directed more ventrally. This procedure is carried out several times in order to advance the needle gradually more ventrally along the vertebral body.

When the needle is advanced to a great

* Presented at the Fifty-fourth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Sept. 29–Oct. 2, 1953.

enough degree ventrally, it grazes the edge of the vertebra and enters the aorta. A rapid drip of blood occurs when the stylet of the needle is withdrawn. The previously filled tubing and syringe are then attached to the needle. The hands holding the syringe are held high and away from the roentgen tube to reduce operator exposure, and the rotary anodes are set in motion. The 12 cc. of contrast medium is then injected in 1–1½ seconds. Just as the injection is about to be completed, a signal is given and the exposure is made. Immediately the needle is withdrawn, and simultaneously the roentgen technicians change cassettes. Within 4–10 seconds a second film is exposed, obtaining a nephrogram. The entire process, from the initial film to the nephrogram, requires 10 minutes, with only 1–2 minutes of anesthesia required for the aortic puncture and production of the arteriogram when an experienced team is performing.

The aortic puncture is the simplest part of the entire procedure. Proper time exposure is more difficult to obtain, and injection of the contrast medium as rapidly as possible is essential.

Fig. 1. Combined arteriogram and left retrograde pyelogram. The pyelogram completely obliterates the left renal angiogram and therefore prohibits its interpretation.

ADJUNCTS TO ARTERIOGRAPHY

The combining of arteriography with other diagnostic techniques has been utilized by us and by others, and is at times of value, yet often it obstructs correct interpretation of the arteriogram.

Renal arteriography in association with retrograde and excretory pyelography has been utilized. We find that the procedure is interesting to perform, but have abandoned it because, more frequently than not, the pyelographic contrast medium partially obliterates the arterial filling (Fig. 1). This obliterates the vascular continuity and can lead to improper interpretation. The use of dilute pyelographic contrast media, 5–10 per cent, lessened this confusion but did not aid in diagnostic accuracy. The combination of arteriography and pyelography demonstrates, most spectacularly, cases of hydronephrosis due to an aberrant artery at the ureteropelvic junction. Excretory urography (Fig. 2) combined with renal arteriography, I do not subscribe to. I do not favor the intravascular injection of large quantities of iodides in such a short period of time. Furthermore, the combination is of no increased diagnostic value over the same two procedures being separated by a period of twenty-four hours. Large quantities of organic iodides injected intravenously has led to fatalities in other types of angiography.

Translumbar ateriography for renal visualization has been combined with perirenal air insufflation by either the lumbar or presacral routes. We performed many air insufflation studies prior to using renal arteriography, and originally we frequently combined the two procedures. There is no advantage in the combined studies, and in renal examination arteriography supplants air insufflation. Because we observed marked unilateral constriction of the renal arteries in 3 of our cases, and a complete lack of renal arteries in another where the procedures are combined, I have discontinued perirenal air insufflation. In our hands, arteriography, for renal diagnosis, provides more accurate information, and more complete information than retroperitoneal air injection or the two com-

Fig. 2. This shows combined excretory urography and renal angiography, demonstrating an aberrant left renal artery with associated hydronephrosis. The pyelogram obliterates the remainder of the arteriogram, however.

bined, but when indicated the procedures should be done separately.

Different operators have changed our technique of translumbar arteriography to satisfy their own needs, and I am certain that some of these have been beneficial. I have not had experience with all the modifications. Some have passed two needles into the aorta, and simultaneously injected contrast media through both needles to increase the concentration of the arterial contrast medium. Others have increased the needle size to No. 14 gauge in order that a greater quantity of iodides may be injected in one to two seconds. I suspect that fatal hemorrhage will occur as an outcome of both these techniques. Sustained pressure apparatus have been utilized to increase the injection rate. Hinman[9] has devised a home-made lever to hold the syringe, so as to use his body weight to increase concentration of contrast medium.

Many of the multiple roentgen-ray techniques presented from time to time have been evaluated by us for use with translumbar arteriography. We have never been able to obtain both good renal arterial detail (Fig. 3) and adequate body-area exposure with a mechanism producing serial arteriograms. This mechanism must have a consistent, dependable film changer which does not produce motion of the patient in its operating mechanics. A good multiple exposure technique for arteriography should be interesting and beneficial in further advancement of this diagnostic procedure. There is no satisfactory serial renal arteriography mechanism at present.

DANGERS OF ARTERIOGRAPHY

Sodium pentothal anesthesia with the patient prone is considered contraindicated, by the anesthetists, because of the inaccessibility of the mouth if the patient develops laryngeal spasm. However, translumbar arteriography can be interrupted at any point. In less than twenty seconds the patient can be turned to the supine position, if necessary. Local anesthesia has been used by us and by others for the procedure, but we fear any sudden motion by the patient while the needle is in the aorta, with resulting aortic laceration. A competent anesthetist is an asset to translumbar arteriography.

Vascular bleeding is the first fear of the procedure. This does occur occasionally, I am certain. I have seen 3 such cases at the time of left kidney exposure, when the kidney was explored within a week after aortic puncture. Upon exposing the renal fossa, dark clotted blood was seen in the perirenal fat. (Careful exploration must be made in order to rule out bleeding from the twelfth intercostal artery, which can have been punctured.) The quantity of bleeding in these 3 cases was not great, but was definitely appreciable. The patients in whom it was seen did not have arteriosclerosis. We have had no fatalities in our series of over 1,200 arteriograms, and the likelihood of fatal hemorrhage, when a No. 18 gauge needle is used, is minute. This is especially so when it is appreciated that our series includes 75 purposely studied hypertensives, in addition to many other patients with hypertension who were evaluated for

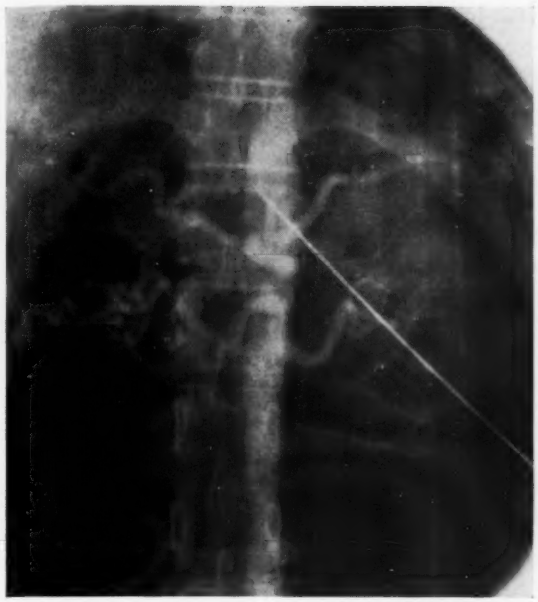


Fig. 3. One film from a serial arteriogram illustrating lack of body area filmed, poor detail of the renal arterial tree, and markings upon film on left side by the propulsion mechanism of the machine.

renal abnormalities. Arteriosclerosis is not a contraindication to arteriography.

Iodide sensitivity of the patient is not a great danger. Intravenous injection of 0.5 cc. of the preferred contrast medium is the only reliable test for sensitivity. A period of five minutes' observation of the patient afterwards is essential. Adrenalin, antihistamines and barbiturates are a necessity for treatment of iodide sensitivity in a department carrying on excretory urography or arteriography.

Extra-aortic or intramural injection of contrast medium will occur. When it does, the patient will have back pain, discomfort upon deep inspiration, and occasionally abdominal pain. We have upon two occasions seen intramural injections of the splenic artery without ill effect. Originally inorganic iodide solutions were utilized for aortic injection. Accidental injection of the celiac axis in these patients caused a mesenteric thrombosis. However Milick, in an excellent experiment on dogs, demonstrated the lack of arterial spasm when the excretory urographic preparations, before mentioned, were injected directly into the superior mesenteric artery under direct vision. This was opposed by the severe arterial spasm and resulting mesenteric thrombosis when sodium iodide was utilized. In our series of patients, approximately 20 cases of accidental celiac axis and superior mesenteric artery puncture have occurred, with the entire quantity of the contrast medium being injected. However, no fatality has resulted. Such patients are more apt to complain of abdominal pain than are those properly injected. Some operators, after aortic puncture, have injected several cubic centimeters of contrast medium, exposing a film at the time to ascertain proper puncture. After viewing the film, if necessary, the puncture site is adjusted. Proper aortic puncture is easily obtained if the twelfth thoracic vertebra is definitely located and the needle advanced to it. Failure to follow the proper technique of a precise procedure can be expected to lead to trouble. The dangers of increased anesthetic time can be avoided by proper technique of puncture; the danger of celiac axis or superior mesenteric artery injection is not appreciable with the organic iodides.

Pendergrass and his associates[14] have shown the danger of anuria when iodides are given intravenously to patients with renal failure. The resulting anuria in these patients, upon whom excretory urography was performed, applies in arteriography also. A stabilized blood-urea-nitrogen, elevated to no more than 40 milligrams per cent, is considered safe. An advancing blood-urea-nitrogen, less or more than this figure, is a contraindication to renal arteriography. We have not seen oliguria or anuria resulting from arteriography.

Any patient who is not a good anesthesia risk should not be subjected to the procedure. If the patient cannot tolerate sodium pentothal, we have upon several occasions utilized high spinal anesthesia with good results, although it is a long-lasting anesthetic for such a short procedure. However, the patient who is too ill to tolerate an anesthetic is better without a diagnosis by renal artery visualization than is his death

from an acceptable and worthwhile procedure.

I have knowledge of 4 patients in whom paraplegia or hemiplegia existed following arteriography. This has not occurred in our series, but the possibility of such a condition resulting is understandable. In 3 of the 4 patients a satisfactory arteriogram was obtained from the puncture of the aorta and the resulting injection. The aorta at the proper level of the puncture lies slightly to the left side of the mid-vertebral line, thus making approach to the structure from the left side feasible. If in passing the needle to the twelfth thoracic vertebra the intravertebral cartilage is encountered rather than the vertebra, the above-mentioned complications can develop. The needle can be passed through the cartilage, through the spinal canal, and on to the aorta. I always remove the stylet of the needle when the resistance of bone or cartilage is first encountered. On two occasions I have seen spinal fluid come from the needle. In each case the needle was reinserted and the proper approach to the aorta made, with production of a satisfactory arteriogram. The above neurological lesions are not the result of the type of contrast medium utilized, but rather of improper puncture technique. The operator, in making the puncture, must be aware of the difference in resistance of muscle, cartilage, bone, and the aorta. All have a different degree of resistance, and cartilage has a very typical spongy resistance.

VALUES OF ARTERIOGRAPHY

The values of this type of arteriography have been well reviewed by Nelson,[11,12] Doss,[2,5] Evans,[7] Smith, Rush and Evans[17,18] Smith, Evans, Elsey and Felson[19], Melick and Vitt,[10,20] Wagner, Price and Swenson,[21] and Harvard.[8] The reports of these authors all bear out the original statements of dos Santos, and present additional findings.

Space-consuming renal lesions and their etiology are a common problem to all roentgenologists and urologists. Until the application of arteriography by the diagnostic urologist, he should not expect accuracy in the preoperative differentiation of renal cysts and tumors. The arteriogram of a renal cyst is typical in that it presents a devascularized area, as would be expected. The tumor, by its nature, is exactly the opposite when the tissue is not necrotic. A renal neoplasm possesses increased vascularity and, because of its atypical cellular growth, has an atypical vascular pattern characterized by irregular arteries, increased and decreased caliber of arteries in continuity, and possibly arteriovenous fistulas. The resulting pattern on the arteriogram is a "tumor stain," or puddling and pooling of contrast medium with an additional irregular and sometimes increased arterial pattern (Fig. 4). Careful inspection of the arterial tree of renal tumors is seldom misleading.[15] We have seen only 1 proved case (Fig. 5) of an apparently misleading arteriogram in 50 renal malignancies.

Renal function is an important determination. Divided renal function tests are frequently essential to the urologist as a guide to proper therapy. The usual divided function examinations, in use at the present time, have many pitfalls and shortcomings. They are gross determinations, and usually show decreased renal function only after marked renal deterioration. Hydronephrotic renal pelves and ureters may retain the contrast media normally used for renal function study, and thereby present false values of retarded function (Fig. 6). Arteriography demonstrates the quantity of the blood supply to the kidney, not only of the renal artery, but of the arcuate and interlobular arteries as well. Any process that destroys the renal parenchyma destroys proportionately these arterial structures. In good arteriograms this arterial diminution, or atrophy of arteries, is perceptible. By experience, therefore, potential renal function can thereby be determined; the function of the renal parenchyma can only be as normal as its blood supply. We utilize arteriograms as an indicator of potential renal function in patients with hydronephrosis, chronic nonobstructive pye-

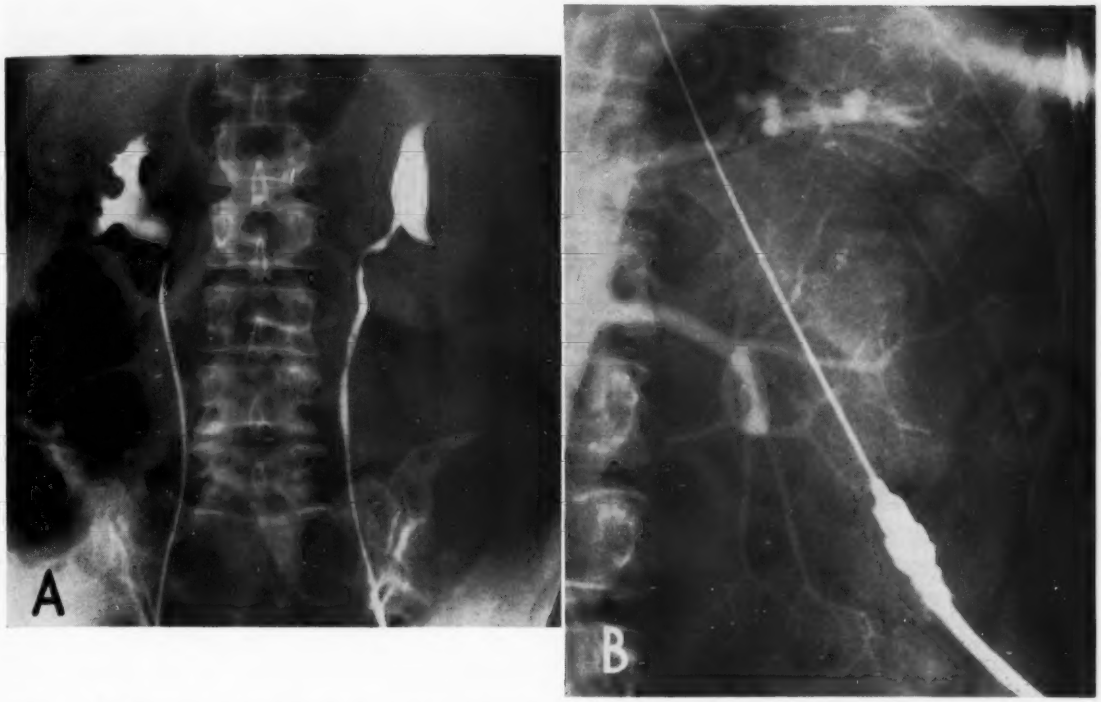


Fig. 4. (*A*) Retrograde pyelogram reveals a space-consuming lesion of the left kidney that could be either solitary cyst or tumor. (*B*) Arteriogram reveals excellent blood supply to the left kidney. Note the peripheral puddling and pooling as well as irregular and increased vascularity. Centrally there is a lack of puddling and pooling and vascularity due to necrosis of the tumor.

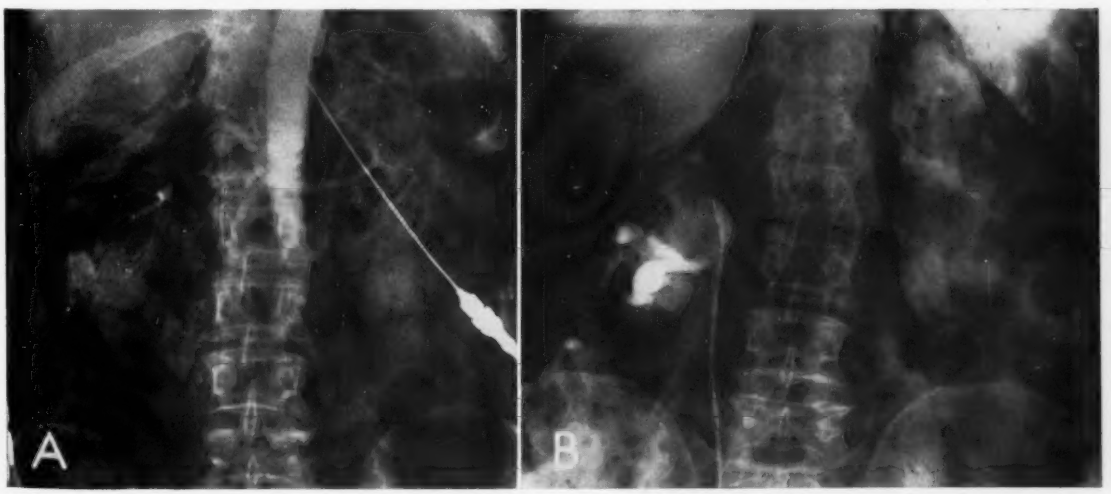


Fig. 5. (*A*) Arteriogram combined with presacral pneumography illustrating a lack of blood supply to space-consuming lesion demonstrated in retrograde pyelogram on the right in (*B*). The space-consuming lesion was renal cell carcinoma. This is our only case of failure to diagnose a parenchymal neoplasm by arteriography. Presacral pneumography was likewise of no benefit.

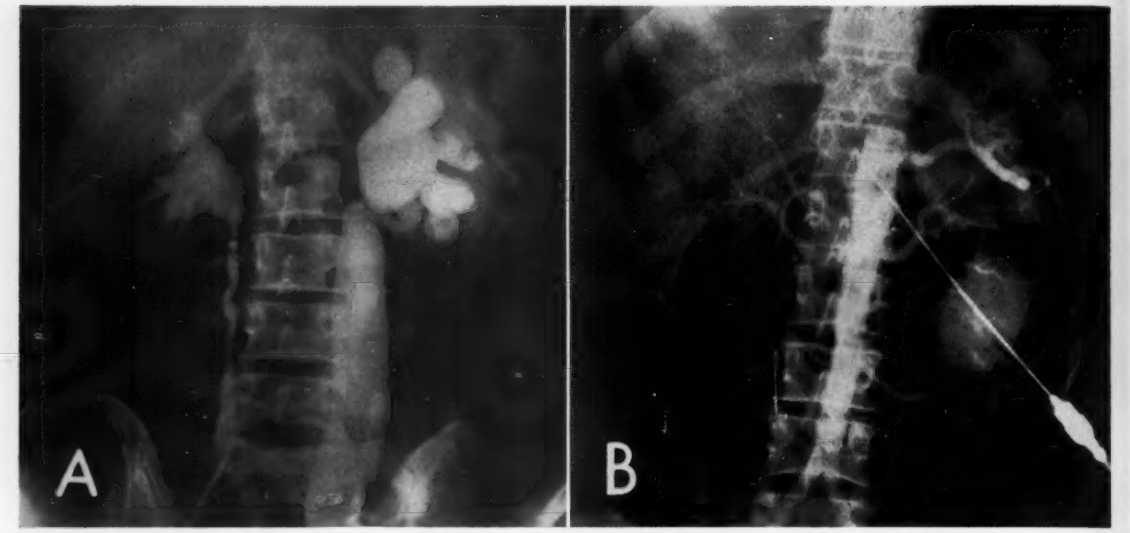


Fig. 6. (*A*) Advanced left hydroureter and hydronephrosis with suspected poor left renal function as determined by divided contrast medium function studies. (*B*) Arteriogram demonstrates excellent blood supply to the kidney and thereby excellent potential renal function. At operation the renal parenchyma appeared to be normal.

lonephritis, or in cases of an apparently normal kidney when the opposite kidney is being considered for nephrectomy.

Renal arteriography is of utmost aid in the study of the kidney whose ureter is completely obstructed. In fact, it is the only procedure which will provide accurate information about the status of this kidney. A kidney which is not functioning because it is obstructed by a ureteral calculus and is inaccessible by ureteral catheter, presents the urologist with a problem of whether the kidney can be salvaged or not. The arteriogram demonstrates the potential renal function by visualizing the arterial system of the kidney in question (Fig. 7).

Anomalous renal arteries can usually be determined at the time of surgery. However, pre-surgical realization of the presence of aberrant arteries to the upper renal pole facilitates freeing of the kidney without inadvertent rupturing of arteries to this area, which is surgically accessible only with difficulty. Anomalous vessels to the lower renal pole often produce ureteral obstruction. Correction of this obstruction requires either arterial and venous sectioning or re-anastomosis of the ureter to the pelvis on the opposite side of the vessels. Vessel sectioning, when there is no associated ureteral wall fibrosis or narrowing of the lumen, is the most practical and universally acceptable and successful procedure. However, if the sectioned vessels devitalize too great a portion of the kidney, the procedure, of course, is contraindicated. At the time of exploration an anomalous renal artery can be temporarily obstructed by a clamp, to determine the portion of the kidney supplied by the particular artery. However, by the arteriogram, the quantity of the kidney supplied by the aberrant vessel is very accurately delineated. We are in agreement with Doss,[5] who believes that more can be learned about the arterial structure of the kidney from the arteriogram than at the operating table.

Renal arterial visualization has proved value in renal trauma. We subscribe to conservative therapy for patients with acute renal trauma, though after acute renal hemorrhage has become quiescent, an arteriogram provides far greater information about the viability of all portions of the kidney than any other type of roentgen study (Fig. 8). The above study is the only accurate indicator for institution of proper therapy such as nephrectomy, hemine-

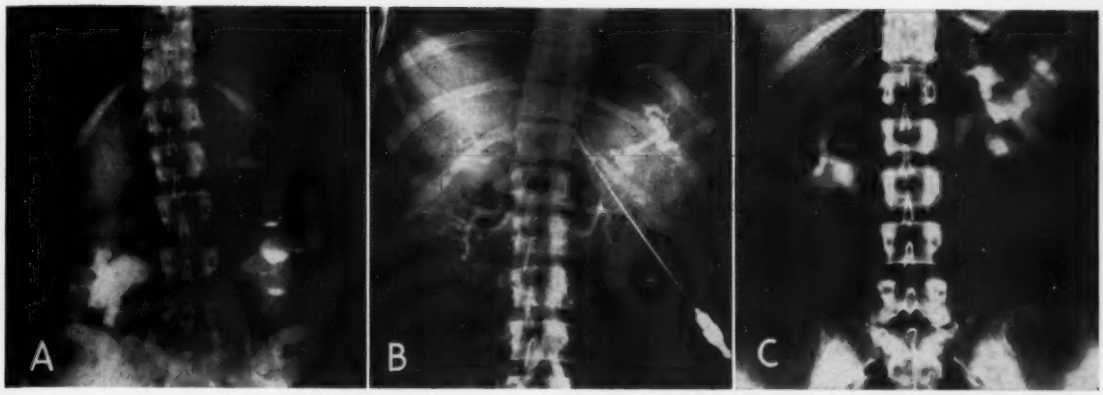


Fig. 7 (*A*) Left ureter obstructed by impassable calculus with resulting advanced hydronephrosis. (*B*) Arteriogram reveals excellent blood supply to the obstructed kidney indicating removal of obstructive calculus alone as proper therapy. (*C*) Six weeks after left ureterolithotomy, intravenous urogram illustrates return of left kidney to nearly normal.

phrectomy or the lack of necessity to intervene surgically in patients with severe renal trauma. I find no other references to this application of arteriography in the literature, yet in our experience we find it one of the most helpful.

Congenital abnormalities of the kidney are frequently seen by the urologist, probably most frequently because of their associated infection. These anomalies may be of position, rotation, form, volume or number. In a great percentage of these abnormalities there is also anomalous blood supply. We have produced arteriograms upon two occasions on patients with fused cross-renal ectopic kidneys. On one occasion the one renal artery supplied both kidneys—three to the lower kidney and one to the upper. These anomalous kidney types frequently require nephrectomy, heminephrectomy or pyeloplasty. Surgical procedures upon anomalous kidneys may be tedious because

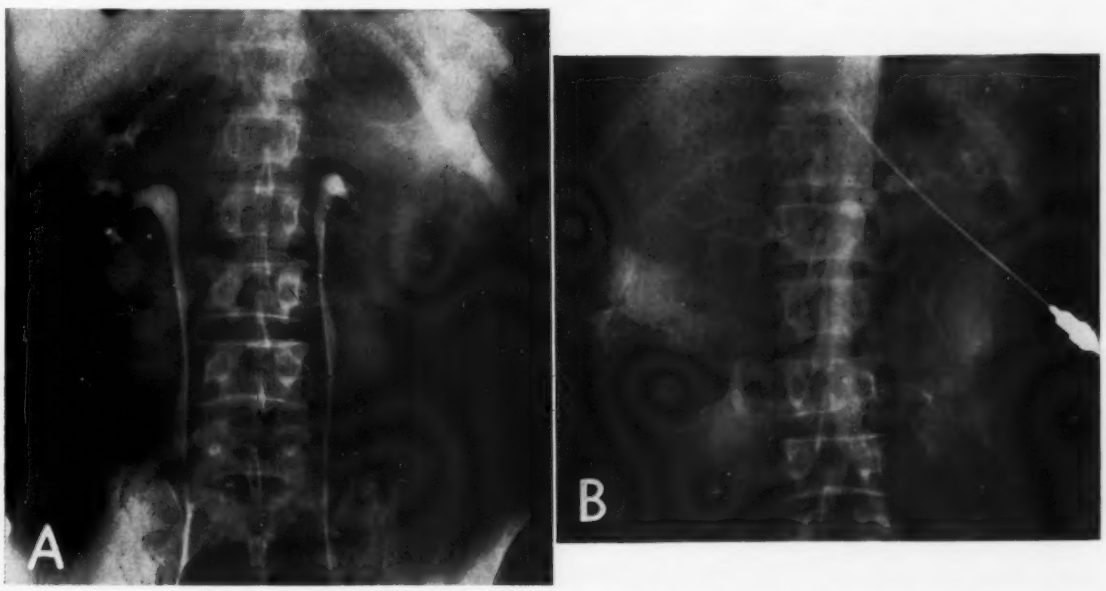


Fig. 8. (*A*) Retrograde pyelogram demonstrates failure of left kidney, the site of traumatic hematuria six weeks before, to fill properly. (*B*) Arteriogram demonstrates blood supply only to lower pole of left kidney. Pathologic examination of kidney revealed infarction of upper three-fourths.

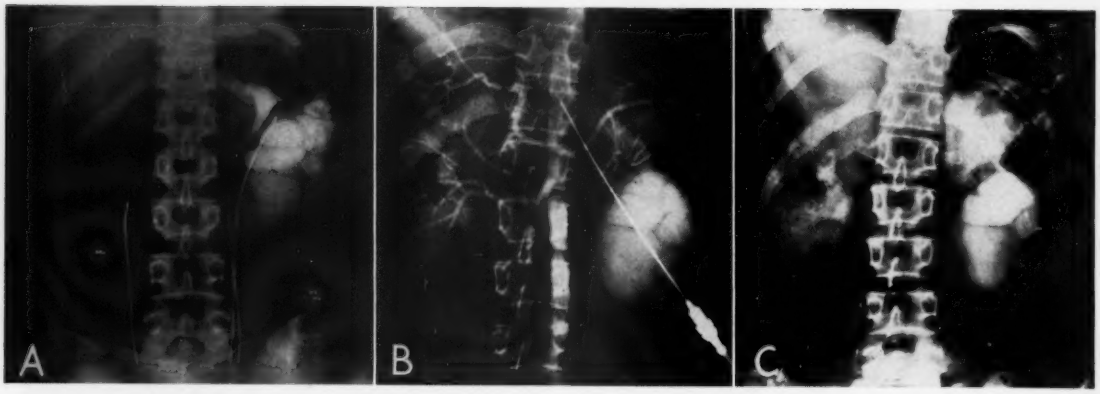


Fig. 9 (*A*) Retrograde pyelogram demonstrates fused double left kidney with double ureters. Lower kidney is nonfunctioning and hydronephrotic. (*B*) Arteriogram reveals excellent blood supply to upper pelvis and parenchyma and an easily resectable lower kidney as to blood supply. (*C*) Nephrogram demonstrates presence of renal parenchyma at upper pole, but no appreciable amount to lower pelvis. The hydronephrotic portion only of the double kidney was resected.

of their peculiar vascularity. We have always operated upon ectopic kidneys transperitoneally for this reason. Arteriography has greatly lightened the uncertainty of renal exploration in these patients because postoperatively the exact source or sources of the blood supply are known. Patients with double kidneys frequently require resection of one-half or the entire kidney. Surgical removal of one portion of a double kidney depends upon being able to separate the kidneys without destroying the vital blood supply of the renal pelvis and parenchyma worthy of salvage. A proper line of cleavage is ascertained with accuracy with the renal arteriogram (Fig. 9).

Arteriography has not been found to aid in diagnosis in cases of polycystic renal disease. In our series there has been a great enough distortion and destruction of the renal parenchyma to cause the arterial pattern to be spread out and to have become greatly diminished. It is possible to see a similar vascular pattern in advanced hydronephrosis, or marked replacement of the renal parenchyma by fibrosis. Early in the disease the distortion is so small that the diagnosis is not ascertainable. Potential renal function can be determined in renal polycystic disease, with resulting information about the prognosis, but the most accurate means of diagnosing polycystic disease is still pyelography.

Our experience with renal arteriography, in cases of renal tuberculosis, is far too limited for any conclusions to be drawn. We hope that some other clinic, which treats large numbers of such cases, will provide information as to whether localized caseous renal areas may be definitely detected by the arteriogram, and further determine whether the size and location of a tuberculous abscess can also be ascertained. From this information, appropriate therapy may be more accurately instituted.

INTERPRETATION

Interpretation of the arteriogram is by far the most difficult part of this diagnostic study. The normal arteriogram must be thoroughly appreciated. Our large series consists of 60 per cent normal studies or technically unsatisfactory arteriograms, the latter representing 25 per cent. We do not hesitate to declare an arteriogram unsatisfactory. In such an event the arteriogram is repeated the following day if deemed necessary. The most common mistake we have made, in our series of cases, is attempting to interpret unsatisfactory arteriograms. This leads to misdiagnosis.

What constitutes a good arteriogram? One important factor is proper location of the contrast medium in the arterial tree. If

the renal system is not completely filled, or has passed filling, mistakes occur. Proper filling of the arterial tree is a matter of correct timing of exposure; exposing the film too early or too late causes the above faulty films.

Poor concentration of the contrast medium in the arterial tree causes a faint arterial pattern and resulting lack of definite arterial continuity, which can be most misleading. One must be able to follow with certainty the individual arteries and their branches in order to be certain about a diagnosis. Failure to inject the contrast medium rapidly enough spreads the material sparsely over a wide area and produces a lack of proper opacity.

Other factors that make interpretation difficult, even if the above-discussed exposure timing and injection rate are correct, should be listed. These are fundamental, and do not require enumeration. The obese patient never produces as striking contrast medium opacity as the slender one. Overlying gas or fecal material may obscure a portion of the renal-arterial tree. Rib cartilages may present confusion. The patient's breathing may cause loss of sharpness of the arterial pattern. Puncture of the aorta below the renal artery may produce poor filling of the renal arteries.

Fig. 10. Overlapping of renal and splenic vessels on the left side make certain interpretation of arteriogram difficult.

Fig. 11. Arteriogram demonstrates good renal angiogram on the left with failure of the right renal artery to fill in spite of the normal right kidney.

One of the most confusing and disturbing difficulties, and something beyond our control, is the overlapping of hepatorenal circulation, splenorenal arterial configuration, or overlying superior mesenteric vessels (Fig. 10). This frequently prevents proper tracing of the arteries, and in these cases, repeat arteriograms are identical. Such arteriograms must be given a diagnosis, as "possibly such," and then only after careful study.

Incorrect diagnoses may result from complete lack of normal renal arteries to fill. We have seen one patient in whom, on three occasions, the renal artery failed to fill, yet the excretory and retrograde pyelogram was normal, and methylene blue excretion was in normal time and concentration from the kidney in question (Fig. 11). There is no explanation for this rare but always possible failure of a normal renal artery to visualize. I do not believe this unexplained abnormality could lead to im-

proper diagnosis or therapy if the patient were correctly and thoroughly examined. Further, it is unlikely that any urologist proceeding to the extent of making an arteriogram will fail to examine the patient adequately by routine methods before arteriography is employed.

We have found that lower aortic obstruction, be it partial or complete, may cause a peculiar disturbance of normal filling of the renal artery. The most unusual effect seen in these patients is the delayed entrance of the contrast medium into the renal arteries. We have seen this in 4 patients; in 1 of them on three occasions. This finding is the reverse of what one would expect. I am certain that it has not been due to extrinsic pressure upon the renal artery, because in 2 patients possessing lower abdominal aortic aneurysms, the masses were located on the opposite side from the more definite peculiar arterial visualization. I have no explanation for this phenomenon.

Proper interpretation of arteriograms depends upon a knowledge of the normal aortic tree and familiarity with the normal arteriogram; there must be proper filling of the renal arteries and end arteries at the time of the roentgen-ray exposure. Good arterial contrast is helpful along with sharp delineation of arteries in making an accurate diagnosis. The nephrogram is often helpful as an aid in diagnosis, as in the case of a renal cyst and its corresponding lack of density. Familiarity with the particular peculiarities of various pathological changes of the kidney is required of the examiner. Lastly, the exposure of the film must be satisfactory.

SUMMARY

An attempt has been made to present briefly what we consider a simple and rapid technique for producing translumbar arteriograms. The few dangers from the procedure have been stressed purposely, and have probably been exaggerated. The values have been only briefly presented, as they have been thoroughly reported elsewhere. The diagnostic errors and factors that lead to these errors have been stressed. Arteriography is a valuable safe procedure, simple to perform, but it requires careful study, and knowledge of the normal as well as the abnormal, to arrive at a correct diagnosis. Experience is still a great teacher, and particularly to us in the field of arteriography. The procedure supersedes presacral air insufflation and perirenal air insufflation in renal diagnosis. It goes beyond pyelography in many cases of renal abnormality. However, it is not a procedure to replace pyelography.*

1908 Union Central Building
Cincinnati 2, Ohio

ADDENDUM

Following the presentation of this paper I was informed that at one clinic 2 patients have been studied who had developed a nonfunctioning kidney following translumbar arteriography. In each patient the aortic puncture was improperly made at the level of the renal arteries. In addition, in both patients, the entire amount of contrast medium was injected into one renal artery. In each case the particular kidney became nonfunctioning. This is not hard to understand, and requires me to call back, for study, all the patients in our series who have had a similar type of injection. All the organic iodides used produce vascular spasm and irritation. What has happened to the kidneys of the 2 patients under consideration is therefore understood. The renal arterial trees were put into such marked spasm and irritated so greatly that ischemia resulted followed by thrombosis of the vessels, with the end result being the expected devitalization of the kidneys in question. The above can be avoided by proper technique of puncture.

The procedure of translumbar arteriography is a necessity to the well trained urologist. It has some dangers, as do all such procedures. In cases where it is applicable it should be utilized, but not taken lightly.

REFERENCES

1. Burns, E. Clinical diagnosis of tumors of adult renal parenchyma. *J. Urol.*, 1953, *70*, 9–14.
2. Doss, A. K. Translumbar aortography; its

* For discussion see page 606.

diagnostic value in urology. *J. Urol.*, 1946, *55*, 594–606.

3. Doss, A. K., THOMAS, H. C., and BOND, T. B. Renal arteriography, its clinical value. *Texas State J. Med.*, 1942, *38*, 277–280.
4. Doss, A. K. Management of ureteropelvic juncture obstruction: translumbar aortography an adjunct. *J. Urol.*, 1947, *57*, 521–541.
5. Doss, A. K. Translumbar aortography; aid in management of hydronephrotic kidney. *South. M. J.*, 1947, *40*, 376–382.
6. DOS SANTOS, R., LAMAS, A. C., and CALDAS PEREIRA, J. Arteriografia da aorta e dos vasos abdominalis. *Med. contemp.*, 1929, *47*, 93–96.
7. EVANS, A. T. Translumbar arteriography; preliminary report. *Cincinnati J. Med.*, 1951, *32*, 47–56.
8. HARVARD, M. Renal angiography. *J. Urol.*, 1953, *70*, 15–19.
9. HINMAN, F., JR. Simple injector for aortography and intravenous angiography. *J. Urol.*, 1953, *70*, 119–120.
10. MELICK, W. F., and VITT, A. E. Present status of aortography. *J. Urol.*, 1948, *60*, 321–334.
11. NELSON, O. A. Arteriography in diagnosis of upper abdominal conditions. *Northwest Med.*, 1945, *44*, 314–322.
12. NELSON, O. A. Arteriography in renal and abdominal conditions. *J. Urol.*, 1945, *53*, 521–533.
13. NELSON, O. A. Arteriography of abdominal organs by aortic injection; preliminary report. *Surg., Gynec. & Obst.*, 1942, *74*, 655–662.
14. PENDERGRASS, E. P., CHAMBERLIN, G. W., GODFREY, E. W., and BURDICK, E. D. Survey of deaths and unfavorable sequelae following administration of contrast media. AM. J. ROENTGENOL. & RAD. THERAPY, 1942, *48*, 741–762.
15. REAGAN, G. W., JR., and CARROLL, G. Arteriography as observed in 80 patients at St. Louis City Hospital. *J. Urol.*, 1951, *66*, 467–473.
16. SMITH, P. G., RUSH, T. W., and EVANS, A. T. Technique of translumbar arteriography. *J.A.M.A.*, 1952, *148*, 255–258.
17. SMITH, P. G., RUSH, T. W., and EVANS, A. T. Evaluation of translumbar arteriography. *J. Urol.*, 1951, *65*, 911–923.
18. SMITH, P. G., RUSH, T. W., and EVANS, A. T. Interpretation of translumbar arteriograms. *J. Urol.*, 1951, *66*, 145–152.
19. SMITH, P. G., EVANS, A. T., ELSEY, E. C., and FELSON, B. Translumbar arteriography: its roentgenologic interpretation. AM. J. ROENTGENOL., RAD. THERAPY & NUCLEAR MED., 1952, *67*, 183–196.
20. VITT, A. E., and MELICK, W. F. Studies on translumbar aortography; simple apparatus for translumbar aorteriography. *J. Missouri M. A.*, 1947, *44*, 749–754.
21. WAGNER, F. B., JR., PRICE, A. H., and SWENSON, P. C. Abdominal arteriography; technique and diagnostic application. AM. J. ROENTGENOL. & RAD. THERAPY, 1947, *58*, 591–598.

ABDOMINAL AORTOGRAPHY FOR THE ROENTGEN DEMONSTRATION OF THE LIVER AND SPLEEN*

By LEO G. RIGLER, M.D., *and* PAUL C. OLFELT, M.D.†
From the Department of Radiology, University of Minnesota Medical School
MINNEAPOLIS, MINNESOTA

DISEASES of the liver still represent a relatively unexplored area in medical diagnosis, and they often present extremely difficult diagnostic problems. Numerous liver function tests have been devised and are being used with some degree of success, particularly through the use of the so-called "liver profile," an accumulation of various laboratory tests. Despite these advances, however, there are many lesions of the liver which are still not amenable to diagnosis premortem, or without exploratory surgery and biopsy. Particularly among this group are the tumor metastases, some of the primary tumors of the liver, certain of the liver abscesses, and some of the more difficult cases of cirrhosis.

Over a period of many years many ingenious efforts to make the liver and spleen visible in the roentgenogram have been undertaken. It is possible to visualize these organs with some degree of success in ordinary roentgenograms of the abdomen, but only the contours can be made out and these rather indefinitely. By means of pneumoperitoneum it is possible to make the outer contours of the liver more clear-cut and the determination of its size, shape, and general position more certain. By such methods, however, no evidence whatsoever as to the internal structure of the organ can be obtained.

The complex anatomical structure of the liver suggests many possibilities for the introduction of a contrast medium to make its internal structure roentgenologically visible. There are at least five systems of tubes in the liver, formed by the biliary ducts, the lymphatics, the hepatic arteries, the portal veins, and the hepatic veins. All of these communicate with each other and with the parenchyma of the liver through the sinusoids. Mixer, Rigler and Oddone[10,18] were able to demonstrate experimentally and clinically that it is possible to flood the sinusoids with contrast medium injected into the common hepatic duct so that it is carried away by the lymphatics and veins. In the parenchyma of the liver there are the hepatic cells and the reticuloendothelial cells. The latter are, of course, also found in the spleen. Here, too, a direct communication between the parenchyma of the organ and the splenic vein, and thus to the portal veins, is present. Any one of these structures would seem to lend itself well for the introduction of contrast substances, either through a direct anatomical route or through the physiological functions of the liver.

The first efforts in the direction of roentgen opacification of the liver came about when contrast cholecystography was introduced. It became evident at once, however, that the amount of contrast medium necessary to give sufficient density to this very large structure was of such an order as to introduce toxic effects and it was found to be impractical. There followed the intravenous injection of thorotrast, first proposed by Radt[16] and Oka,[13] in 1929. In this method, the reticuloendothelial system of the liver became opacified through its ingestion of the colloidal contrast material from the blood. From the point of view of the production of contrast in the liver and the delineation of abnormalities, this method was most effective. Unfortunately, the almost permanent retention of the contrast medium within the liver and spleen, and in other organs in which there is reticuloendothelial tissue, and the minor

* Presented at the Fifty-fourth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Sept. 29–Oct. 2, 1953.
† Clinical Fellow, American Cancer Society.

degree of radioactivity of thorium dioxide has led to fears that injury might result. We have, in our experience, observed patients as long as twenty years after the introduction of this material with some of it still remaining in the liver, spleen and lymph nodes. We have observed the spleen shrinking sharply under the influence of the material and the development of some degree of increased fibrous tissue in the liver. Although these changes have been present, intensive studies, many years later, on patients who have received thorotrast in reasonable amounts have not revealed any serious effects, either in liver function or in the histological appearance as seen at autopsy.[17] Nevertheless, it is hazardous to introduce a contrast medium, which will remain there permanently, into such a vital structure as the liver, especially since it is done purely for diagnostic purposes. For this reason, this method, to a large extent at least, has been abandoned and we, ourselves, use it only upon very special occasions in elderly individuals in whom the failure of excretion would seem to do no harm. Its usefulness, therefore, is sharply limited.

Degkwitz,[7] and others[2,14] later, introduced other types of colloidal contrast media involving iodine as the major element. Similar compounds are still available; they depend largely upon the absorption into the liver through the reticuloendothelial cells of a colloidal material which breaks down fairly rapidly, and is therefore excreted. Furthermore, it is not radioactive. Unfortunately, such materials may have severe toxic effects and some deaths have resulted so this method, likewise, has been largely abandoned.

In more recent years, Olsson and Ekman[15] have tried to develop a medium which depends upon a special affinity of fat for iodine; this would likewise be excreted by the liver and thus opacify it but would be less toxic. Successful in the experimental animal, they have not yet been able to develop a material which would be utilizable in the human.

The introduction of contrast medium into the biliary ducts, cholangiography, has served in some small measure for generalized visualization of the liver or, at least, of the small biliary ducts. This has been done largely through the medium of direct introduction into the common duct, either directly at operation, or by means of injection through a drainage tube placed there at that time. Such procedures are sharply limited in their utility since only the biliary duct system and occasional abscesses communicating with the biliary ducts or cholangiectasis can be demonstrated. The presence of tumors in the liver, while distorting to some degree the biliary duct system, cannot be clearly delineated in this way. The more recent efforts to visualize the ductal system through simple cholecystography or through the introduction of a contrast medium into the gallbladder directly through the abdominal wall, guided by peritoneoscopy, have also had a most limited field of usefulness.

Moore and Bridenbaugh[11,12] have made both the portal venous circulation of the liver and the parenchyma of the liver itself roentgenologically visible through the procedure of introducing a contrast medium into the portal venous circulation at operation. Taking advantage of the diffusion from the veins into the liver parenchyma they were able to study the whole liver as well as the portal veins. Although this is an effective method for the demonstration of the liver, it is sharply limited by the fact that it can only be done through the opened abdominal wall.

More recently, Steinbach and his coworkers[3,20] have studied the portal venous circulation roentgenologically by injection of contrast medium directly into the liver through the anterior abdominal wall, striking one of the branches of the portal vein. This procedure, likewise, is laden with difficulties and hazards which one is reluctant to accept.

The visualization of the portal venous system, and to a lesser degree of the liver parenchyma, can be achieved through

direct splenic puncture with injection of contrast medium into the pulp of the spleen.[1,21] The material finds its way from the parenchyma of the spleen into the splenic vein and then infuses the portal venous circulation. It is an effective means for the demonstration of the portal venous system, but the amount of contrast introduced and its slow diffusion into the liver is of such an order that clear opacification of the parenchyma of the liver cannot be obtained. Furthermore, there is a real risk involved here as we have found in our own observations; namely, that of penetration through the capsule of the spleen into the peritoneum, thus injecting contrast medium around it, or of splenic hemorrhage following the introduction of the needle. The latter is particularly a risk in the cases in which a pathological process is present.

Abdominal aortography is a procedure of long standing, but only in the last five years has it been used widely in this country. Certain modifications in this procedure have been introduced by Krumbach[4,8] and elaborated by us in a previous paper.[19] The changes have made it possible to visualize more effectively the hepatic and splenic arteries and to introduce sufficient contrast medium through these two arteries and by return from the mesenteric vessels to give adequate opacification of the liver and spleen. This is of such an order as to permit identification of the portal circulation, of metastases, and of other lesions of the liver.[19] Furthermore, it is possible, by this means, to demonstrate that involvement of the liver in a generalized fibrotic process, such as ordinary cirrhosis, produces greatly diminished or remarkably delayed opacification.

The technique we have used involves three changes from that previously used. First, the needle is introduced into the back just below the eleventh rib with it directed medial but also markedly cephalad so that the point enters the aorta well above the eleventh segment. Second, 40 cc. of contrast medium is injected through a size 16 needle as rapidly as possible, the duration being about three seconds. Third, we have used 70 per cent urokon (sodium 2,4,6, triiodo 3 acetylaminobenzoate) as a contrast medium and find that its roentgen opacity is somewhat greater and its irritative effect somewhat less than that of other concentrated organic iodides previously used. The result of the higher point of injection and the large quantity of contrast medium is shown in Figure 1. Here the distal half of the thoracic aorta, and the whole celiac axis are well opacified. The hepatic and splenic arteries are thoroughly filled with the contrast medium. Likewise there is extensive filling of the superior mesenteric artery as well as the normal delineation of the remaining abdominal aorta, the renal arteries, and the remaining branches.

For examination of the liver and spleen we have attempted to make serial roentgenograms of the abdomen at frequent intervals after the injection. First, this was done at intervals of four to five seconds, using a conventional table with moving Bucky grid and changing cassettes by hand as rapidly as possible. The point of time after injection at which the films are exposed is crucial if the highest degree of opacification of the liver is to be obtained. The latter is a most important feature of the technique, since it is evident that there will be variations in the amount of contrast within the liver at any one point in the time sequence, depending somewhat upon the return from the mesenteric circulation and from the splenic vein. From our previous experience with portal venography we have appreciated the importance of repeated films at various intervals. In later studies, we have used a Fairchild rapid film changing cassette. The films have been exposed at one second intervals over a period of approximately eighteen seconds following the end of the injection. This has permitted a good survey of the varying degrees of density of the liver. It has also indicated the sequence of events in the liver which follows upon the injection into the abdominal aorta.

The entrance of the contrast medium

into the liver is accomplished in two ways. One is from the actual introduction of the medium into the hepatic artery directly from the abdominal aorta, as indicated in Figure 1. Second, a return flow into the liver comes from the spleen, which is obviously extensively filled with contrast medium through the splenic artery and thus becomes well opacified (Fig. 2). Third, there is a considerable return from the remainder of the portal veins fed by the superior mesenteric. The whole contributes, therefore, to the final opacification of the liver which, in the normal, attains a reasonable density (Fig. 2). As stated above, this is accomplished by reason of the fact that, during the course of passage through the hepatic and portal veins, communication with the sinusoids occurs and there is diffusion of the contrast medium through the substance of the liver itself.

A characteristic series of films, made as described above, in a case with multiple cysts of the liver gives findings as follows. The first film is made after insertion of the needle but before injection of contrast

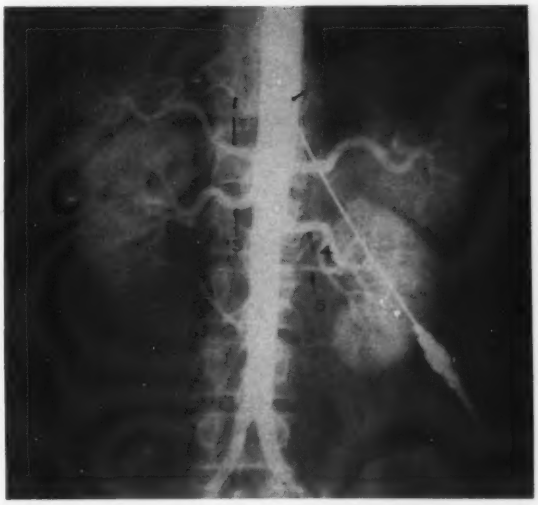


Fig. 1. Aortogram, normal, made with the technique described. Roentgenogram taken just at the end of injection. The thoracic as well as the abdominal aorta is opacified. Note the large amount of contrast medium entering the hepatic (*1*), splenic (*2*), and superior mesenteric (*5*) arteries. The renal arteries (*3* and *4*) are well seen, as are the other branches of the abdominal aorta. At this period opacification of the kidneys has already begun but the liver and spleen are not yet flooded with contrast material.

Fig. 2. Hepatogram by aortic injection, normal. Roentgenogram made four seconds after the end of injection. The portal (*6*) and splenic (*7*) veins are barely visible but the opacification of the liver (*10*) and the spleen (*11*) has already occurred. Note that the kidneys show the greatest degree of density, the spleen less, and the liver the least. Nevertheless the density of the liver is such that changes in its internal structure become visible.

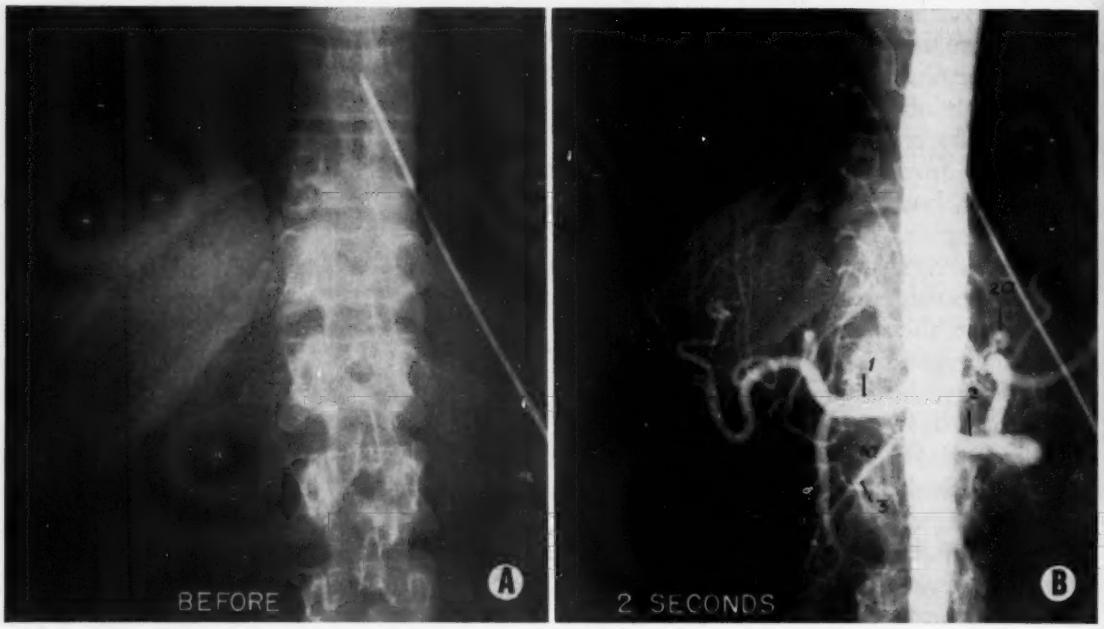


Fig. 3. Hepatogram in a case of cystic disease of the liver. Serial films made at one second intervals. (*A*) Preliminary film before injection. Note the high position of the needle, the point being at the level of the 10th thoracic vertebra. Note the lack of density of the liver. (*B*) Same case two seconds after beginning of injection. Note the opacification of the thoracic as well as the upper abdominal aorta. The hepatic artery (*1*), the right gastric branch (*1a*), the splenic artery (*2*), the left gastric artery (*2a*), and the branches of the superior mesenteric (*3*) are already clearly delineated.

medium (Fig. 3*A*). The second film, made two seconds after the beginning of the injection (Fig. 3*B*), shows the thoracic aorta and a portion of the abdominal aorta. The hepatic, splenic and left gastric arteries are already well filled, but the renal arteries are not yet well seen. The right gastric branch of the hepatic artery and branches of the superior mesenteric artery can also be seen. The coiled, tortuous character of both the hepatic and splenic arteries is well demonstrated but the opacity of the liver is not yet increased. At three seconds the smaller branches of the hepatic artery are more clearly visible and the renal arteries are now well seen, as is the superior mesenteric and its branches. At four seconds (Fig. 4*A*) the contrast medium has now left the thoracic portion of the aorta, to a large extent, and the celiac axis and superior mesenteric arteries are more clearly visible as a result. The smaller intrahepatic branches of the hepatic artery can now be seen. A film made five seconds after the beginning of the injection shows the shadows of the hepatic and splenic arteries fading out to a large extent, the major splenic and hepatic arteries having almost disappeared while the smaller branches still show some contrast. At six seconds the increased opacification of the liver begins to be apparent, while there is still some residual contrast medium in the smaller branches of the hepatic artery. At seven seconds the splenic vein and the portal vein begin to be visible and some of the smaller branches of the portal vein are also visible. The opacification of the liver has increased somewhat but not to its fullest extent. There are already seen, in this case of cystic disease of the liver, several small areas of rarefaction within the opacification. At eight seconds (Fig. 4*B*) the portal vein and its major branches are clearly visible and some of the small branches through the liver are also seen. Opacification of the liver has now increased appreciably. The splenic vein is readily seen. At nine seconds

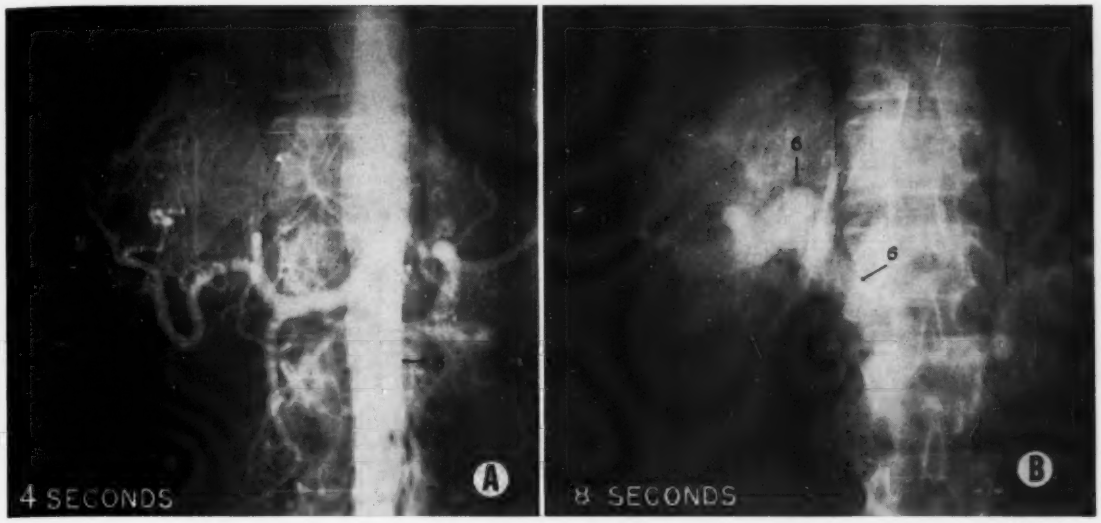


Fig. 4. Same case as Figure 3. (*A*) Serial film made four seconds after beginning of injection. Note diminution of contrast medium in thoracic and upper abdominal aorta. As a result the celiac axis and the superior mesenteric artery (*5*) become visible. Note the numerous intrahepatic branches of the hepatic artery. (*B*) Film made at eight seconds. The portal vein and its branches (*6*) and the splenic vein (*7*) are now seen. The liver is markedly increased in density.

the areas of rarefaction within the opacification of the liver begin to be much more apparent and are fairly clear. At ten seconds (Fig. 5*A*) the major portal vein and its branches can still be clearly made out, as well as the diminished areas of density.

Contrast medium can still be well seen in the splenic vein also. At eleven seconds the height of the contrast in the liver as between the normal parenchyma and the cystic areas which contain no contrast medium is brought out. At twelve seconds the contrast begins to diminish. At fifteen seconds the areas of rarefaction in other portions of the liver are even more visible. The portal vein has begun to disappear. At sixteen

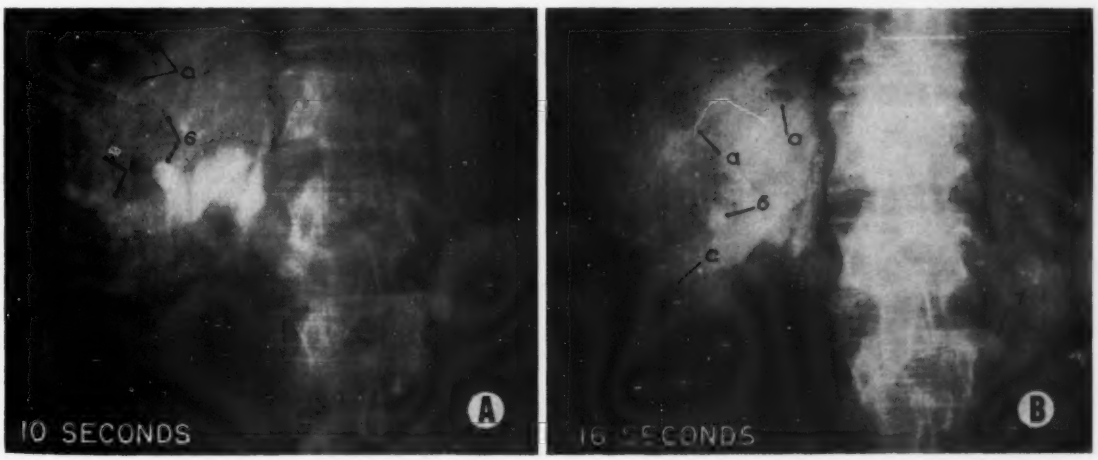


Fig. 5. Same case as Figures 3 and 4. (*A*) Roentgenogram made ten seconds after injection. Intrahepatic branches of portal vein (*6*) are well seen. Defects in the density of the liver shadow (*a*) represent the multiple liver cysts. Such defects might occur with tumors, metastases, or even with abscesses. (*B*) Film made at sixteen seconds. Residue of contrast medium in portal veins (*6*) and in splenic vein (*7*) are shown. The density of the liver is interspersed with numerous rounded areas of lesser density (*2*) resulting from the multiple cysts. In the original film a very large number could be seen.

seconds there is still a slight evidence of the portal vein (Fig. 5*B*). The areas of multiple rarefaction within the liver density, which represent the many cysts, are clearly visible.

In normal cases, the density of the liver is sharply increased as compared to films which were made prior to the introduction of the contrast medium as controls. The density of the liver approaches that of the spleen (Fig. 2), despite its greater size, indicating that the quantity of contrast medium is relatively greater within the spleen than it is within the liver. In some instances there has been a variation in this degree of density, the exact cause of which is not clearly apparent. In the later films the liver seems to be more opacified, relatively, than the spleen. Generally speaking, the degree of intensification of the shadow of the kidneys is much greater than that of the liver, especially in proportion to their anteroposterior thickness. This might be expected from the fact that a very much larger proportion of the blood from the abdominal aorta passes through the kidneys than through the liver.

At approximately eight seconds (Fig. 6), but sometimes as late as twelve seconds after the end of the injection, a fairly good visualization of the entire portal venous circulation, including its intrahepatic branches, can be obtained. This is not constant and the reason for its inconstancy cannot be determined from the clinical findings of the patients examined. In some instances, obvious obstruction to the flow of blood, as in the case of severely damaged, poorly functioning kidneys, appears to increase the amount of contrast medium entering into the portal circulation with unusually vivid demonstration, therefore, of the portal vein, the splenic vein and its tributaries. The individual portal veins can also be made out with a fair degree of clarity within the liver itself. The typical normal appearance immediately at the end of injection and eight seconds later is exhibited in Figure 7.

Fig. 6. Hepatogram, normal, eleven seconds after beginning of injection. The portal venous system is well demonstrated. Note portal vein (*6*) and its intrahepatic branches (*6a*), splenic vein (*7*), right and left renal veins (*8* and *9*) as well as many other venous tributaries of the portal circulation. The opacification of the liver, spleen and kidneys is exhibited.

Animal experimentation on rats, in whom cirrhosis of the liver has been induced artificially by the injection of toxic substances, has been extensively studied by Daniel and his associates.[5,6] They made roentgen studies of the liver by direct injection of contrast medium into the portal circulation. They found a very striking difference in the appearance as between the normal and the cirrhotic liver in such animals. In the normal liver, at a suitable interval after the injection of the contrast medium, there is a fairly uniform density found throughout the entire liver, similar to that which we have observed in our own studies on humans by portal venous injection at the operating table. In the cirrhotic liver, in rats, the venous circulation could be clearly made out but there was such a marked delay in the diffusion of the material through the substance of the liver that at no time was there an effective opacification of the liver as a whole.

Our own experience with cirrhosis is relatively limited and, in some respects, the method does not lend itself well to the study of patients with this disease. The reason for this lies in the fact that patients with cirrhosis of the liver are so frequently affected by abnormalities in the clotting mechanism; as a result, we have been very hesitant in introducing so large a needle

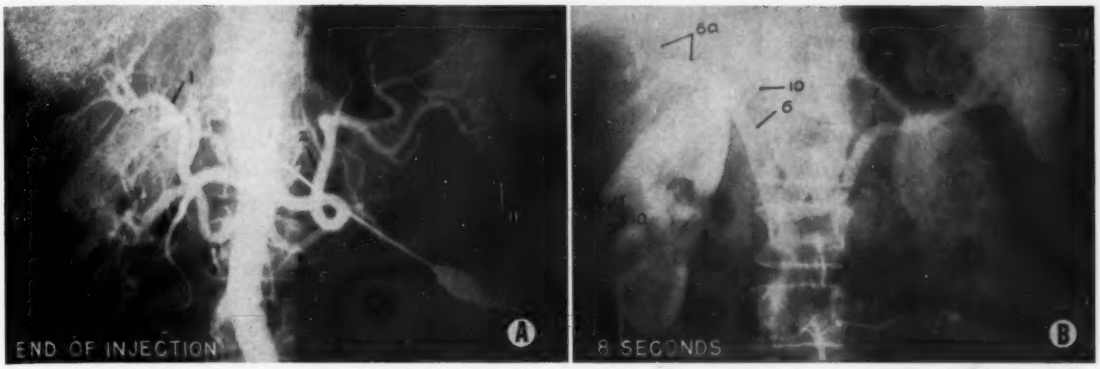


Fig. 7. Normal aortogram. (*A*) Roentgenogram immediately at end of injection. Hepatic (*1*) and splenic (*2*) arteries as well as renal arteries (*3* and *4*) are well demonstrated. Note beginning opacification of spleen (*11*) already. (*B*) Film at eight seconds after beginning injection. The portal vein (*6*) and its intrahepatic branches (*6a*), and the splenic vein (*7*) are well shown. There is a marked opacification of the spleen (*11*) equal to that of the kidneys. The liver edge indicated by arrow *10* is well seen; its density is increased but is less than that of spleen and kidneys.

into the abdominal aorta in such individuals for fear that hemorrhage might occur. In a small number of cases of cirrhosis, however, we have been able to demonstrate effectively exactly the mechanism reported by Daniel *et al.*;[6] namely, that the opacification of the liver does not proceed as in the normal, but rather that there is a very marked diminution in the degree of opacification or no increase in the density of the liver at all as compared to the shadow seen prior to the introduction of the contrast medium. A case of cirrhosis is illustrated in Figure 8. The low density of the liver as compared to that of the enlarged spleen and of the right kidney (the left had been extirpated) is typical. Our experience is not sufficiently advanced to indicate that this would be a reliable diagnostic criterion of cirrhosis, but the preliminary studies indicate that it holds strong possibilities, providing the prothrombin mechanism is sufficiently normal to permit the injection of the contrast medium without danger.

It is obvious at once that this method may give information of value insofar as changes in the extrahepatic portal circulation are concerned (Fig. 6 and 7). Generally speaking, however, in patients who are suspected of obstructions to the portal circulation, such as splenic vein thrombosis and other lesions of this nature, and who would be available for immediate surgical exploration, it would be more valuable to introduce the contrast medium through spleen puncture or at the operating table through direct puncture of the portal vein by the technique of Moore and Bridenbaugh[11,12] than by this method. Nevertheless, in certain cases it may provide important information as to obstruction of the portal circulation within the veins them-

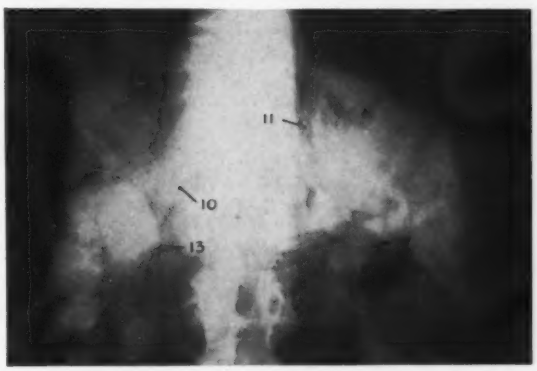


Fig. 8. Hepatogram in a case of cirrhosis of the liver made eight seconds after beginning of injection. Left nephrectomy for hypernephroma had been done a year before. Note the enlarged, well opacified spleen (*11*), the splenic vein (*8*). Some opacification of a part of the liver over the spine and just medial to it (*10*) can be seen. Contrast the over-all density of the liver with that of the right kidney and the spleen. The density of the liver is little or no greater than in the control film made before injection. This is characteristic of cirrhosis.

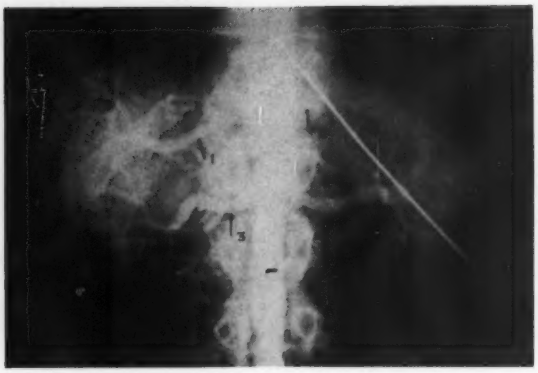


Fig. 9. Aortogram in a case of carcinoma of the pancreas. Roentgenogram made at end of injection. Note the normal hepatic artery (*1*), right renal artery (*3*), left renal artery (*4*). The occlusion of the splenic artery is shown by arrow *2*. Note the absence of any shadow of the spleen although the liver and kidneys are already somewhat opacified.

selves, in contrast to that produced by the obstruction at the periphery of the portal circulation from cirrhosis of the liver. As far as our experience at the present moment is concerned, however, the constancy of the demonstration of the extrahepatic portal circulation is not of such an order that the method would be reliable.

It seems apparent that abnormalities of the arterial circulation of the liver and spleen may also be determined by this procedure. Thus we have seen hemangiomas of the liver exhibited by the tortuosity and dilatation of intrahepatic branches of the artery. In the same way, aneurysms of the splenic artery may be observed. Thrombosis of these vessels may also be detected, as in the case illustrated in Figure 9, in which complete occlusion of the splenic artery occurred secondary to a carcinoma of the pancreas.

It is in the field of tumors of the liver that this process may have its greatest usefulness. Patients with a mass on the right side in whom there is difficulty in distinguishing between a tumor or mass within the liver itself, an unusual lobe of the liver, or a perirenal, retroperitoneal or subhepatic tumor, entirely independent of the liver, can be aided greatly by this method. It is unnecessary here to indicate the utility of this procedure in the distinction between malignant neoplasms and benign cysts of the kidney. Such findings have been detailed by many authors. But a distinction, not so much between benign and malignant lesions, but rather as between a tumor of the liver and a mass arising from neighboring structures, can also be made out. Careful study of repeated films will indicate the direction of the arterial circulation of the liver and whether or not it involves the part to be observed. Furthermore, observation of the opacification of the area under consideration, as contrasted to the remaining portion of the liver, will indicate whether or not the tumor is a part of the liver itself. In several patients with retroperitoneal lipomas, perirenal masses, recurrence of hypernephroma in an area of resection, etc., we have been able to demonstrate that the lesion was extrahepatic. On the other hand, in one case of hepatoma we were able to demonstrate that the tumor actually was a part of the liver itself.

In the field of liver metastases this procedure may be of very great value, particularly in the evaluation of the extent and distribution of such lesions in the liver prior to operation. There are two indications for such a study with respect to surgery. The first is to determine whether metastases are so extensive as to make surgery impossible. The second situation is that in which the surgeon hopes to remove a solitary hepatic metastasis, but needs good evidence before operation to indicate that there are no other metastases elsewhere in the liver.

What form would carcinomatous metastases of the liver take under these circumstances? It is notable that tumors of the kidney which are not necrotic exhibit an increased amount of contrast when abdominal aortography is performed. This no doubt is due to the great capillarity within the tumor itself and the so-called tumor staining is a characteristic phenomenon. However, in the case of necrotic tumors of the kidney, the reverse is true, and we have seen tumors of the kidney in which practi-

cally none of the contrast medium entered because the tumor was almost completely necrotic, with relatively few viable areas.

Studies of the liver removed at autopsy have been made by Lewis and his associates,[9] using a colored plastic to inject the blood vessels. These indicate that in many cases, at least, the metastases in the liver have a greatly deficient, rather than an increased, circulation. This is borne out by the fact that metastases in the liver tend to be somewhat necrotic and somewhat avascular. Furthermore, it is evident that when contrast material is being carried into the liver through the medium of the vascular trunks in the living individual, the presence of metastases compressing the sinusoids in that area would prevent diffusion of the contrast material from the vascular trunks into the substance of the liver and therefore produce areas of defect. Our experience in clinical cases of metastases has borne this out and, in a number of cases, we have been able to observe actual defects within the contrast medium resembling closely those which had previously been seen when thorotrast was used to visualize the liver substance (Fig. 10). On the other hand, we have had a number of cases in which metastases were proved in which no

Fig. 10. Metastasis to liver from hypernephroma, hepatogram. Roentgenogram made ten seconds after end of injection. Solitary defect within opacified liver is outlined by arrows. The difference in density is obvious in the original roentgenograms but difficult to reproduce.

Fig. 11. Hepatogram in a case of metastasis to the liver, later demonstrated at operation. Roentgenogram made eleven seconds after the beginning of injection. Note the good over-all opacification of the liver (*11*) as contrasted with the upper pole of the right kidney (*13*). No defects could be observed within the structure of the liver. Obviously, not all metastases can be visualized by this procedure.

change whatever could be made out in the hepatograms made by abdominal aortography (Fig. 11). This would seem to suggest that in some metastases there is considerable diffusion of the contrast medium through the area involved and, therefore, no defects appear. We have not yet seen any cases in which the tumor staining, so characteristically seen in kidney tumors, appears within metastases of the liver. Within the limits of a small experience it appears, however, that, in many cases at least, this procedure may permit the visualization of metastases effectively, demonstrated as areas of markedly diminished density within the opacified liver as a whole similar to those seen in cystic disease, as shown above (Fig. 5).

Further perfection of the roentgenographic technique is needed. The size of the film used in the ordinary Fairchild cassette is too small for adequate demonstration of the liver and spleen. It would be desirable to obtain at least 11 by 14 inch films at rapid intervals. The circulation being relatively slow, it is probable that two second intervals between exposures would be sufficient. The exposure factors in this part of the anatomy are sufficiently long to make it desirable to keep the number of roentgenograms as few as possible. With such

improvements, however, we believe this to be an adequate method for the roentgen study of the liver and spleen and, within some limits, of the portal circulation.

SUMMARY

A procedure for the roentgen visualization of the liver and spleen by means of the introduction of a contrast medium through the abdominal aorta is described. A rapid exposure technique with multiple films will permit reasonably adequate demonstration of the size, shape, position and internal structure of the liver and spleen. The hepatic and splenic arteries and the portal venous circulation are sufficiently well demonstrated, so that diseases of these structures can be elucidated. Diseases of the liver, itself, especially cirrhosis and metastases from tumors are usually well delineated. Until a contrast medium which is harmless can be introduced into the liver by the oral or intravenous route, the pathway through the abdominal aorta may be the method of choice.*

Leo G. Rigler, M.D.
University of Minnesota
Medical School
Minneapolis 14, Minnesota

REFERENCES

1. Abeatici, S., and Campi, L. Sur les possibilités de l'angiographie hépatique; la visualisation du système portal. *Acta radiol.*, 1951, *36*, 383–392.
2. Beckermann, F., and Popken, C. Kontrastdarstellung der Leber und Milz im Röntgenbild mit Jodsolen. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1938, *58*, 519–535.
3. Bierman, H. R., Steinbach, H. L., White, L. P., and Kelly, K. H. Portal venipuncture; percutaneous transhepatic approach. *Proc. Soc. Exper. Biol. & Med.*, 1952, *79*, 550–552.
4. Creevy, C. D., Krumbach, R. W., and Price, W. E. Evaluation of translumbar aortography. *Bull. Univ. Minnesota Hosps. & Minnesota Med. Fdn.*, 1953, *24*, 413–420.
5. Daniel, P. M., Prichard, M. M. L., and Reynell, P. C. Portal circulation in experimental cirrhosis of liver. *J. Path. & Bact.*, 1952, *64*, 53–60.
6. Daniel, P. M., Prichard, M. M. L., and Reynell, P. C. Portal circulation in rats with liver cell damage. *J. Path. & Bact.*, 1952, *64*, 61–64.
7. Degkwitz, R. Kolloidgestaltung und gezielte intravenöse Injektion. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1938, *58*, 472–484.
8. Krumbach, R. W. Evaluation of aortography as aid to diagnosis in urology. Thesis submitted to Graduate School Faculty, University of Minnesota, 1952.
9. Lewis, F. J. Personal communication.
10. Mixer, H. W., Rigler, L. G., and Gonzales Oddone, M. V. Experimental studies on biliary regurgitation during cholangiography. *Gastroenterology*, 1947, *9*, 64–80.
11. Moore, G. E., and Bridenbaugh, R. B. Portal venography. *Surgery*, 1950, *28*, 827–831.
12. Moore, G. E., and Bridenbaugh, R. B. Roentgen demonstration of venous circulation in liver: Portal venography. *Radiology*, 1951, *57*, 685–689.
13. Oka, M. Eine neue Methode zur röntgenologischen Darstellung der Milz (Lienographie). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1929, *40*, 497–501.
14. Olsson, O. On hepatosplenography with "jodsol." *Acta radiol.*, 1941, *22*, 749–760.
15. Olsson, O., and Ekman, B. Oral hepatography. *Acta radiol.*, 1949, *31*, 33–36.
16. Radt, P. Eine Methode zur röntgenologischen Kontrastdarstellung vom Milz und Leber. *Klin Wchnschr.*, 1929, *8*, 2128–2129.
17. Rigler, L. G., Koucky, R., and Abraham, A. L. Effects of thorium dioxide sol on human liver. *Radiology*, 1935, *25*, 521–532.
18. Rigler, L. G., and Mixer, H. W. Cholangiography and biliary regurgitation. *Radiology*, 1947, *48*, 463–471.
19. Rigler, L. G., Olfelt, P. C., and Krumbach, R. W. Roentgen hepatography by injection of contrast medium into aorta. *Radiology*, 1953, *60*, 363–367.
20. Steinbach, H. L., Bierman, H. R., Miller, E. R., and Wass, W. A. Percutaneous transhepatic portal venography; preliminary report. *Radiology*, 1953, *60*, 368–374.
21. Walker, R. M., Middlemiss, J. H., and Nanson, E. M. Portal venography by intrasplenic injection. *Brit. J. Surg.*, 1953, *40*, 392–395.

* For discussion see page 606.

Vol. 72, No. 4

TRANSLUMBAR ARTERIOGRAPHY IN INTRINSIC DISEASE OF THE ABDOMINAL AORTA AND ITS BRANCHES*

By BENJAMIN FELSON, M.D.
CINCINNATI, OHIO

AS EXPERIENCE with translumbar arteriography accumulates, its value in the diagnosis of intrinsic disease of the abdominal aorta and its branches is becoming more and more apparent. The subject is assuming greater importance in the light of recent advances in arterial surgery, in which thromboendarterectomy, resection, and vascular grafting are now playing an increasing role.

In the initial enthusiasm for arteriography, clear-cut indications for its use were not laid down, particularly in relation to abnormalities of the vessels. A re-evaluation of the effectiveness of this diagnostic method in arterial disease therefore seems indicated.

Personal experience with material culled from a series of over 1,000 translumbar arteriograms has afforded us an excellent opportunity to review the subject and to draw certain conclusions as to the value of the procedure in specific types of arterial disease. In the following paragraphs these conditions are discussed, and the value of arteriography in their diagnosis and management is assayed on the basis of data obtained in our own and other institutions.

ANEURYSM

Aortic. The clinical diagnosis of abdominal aortic aneurysm is usually made on the basis of an expansively pulsating mass. However, this finding is not always reliable, and in 2 such cases in our series arteriography failed to demonstrate an aneurysm. Subsequent exploration revealed carcinoma of the pancreas in one and retroperitoneal sarcoma in the other. A similar case is reported by Wagner, Price and Swenson.[35] Therefore, unless plain roentgenograms reveal typical signs of aneurysm (calcification or bone erosion), arteriography should be performed for diagnostic confirmation.

Recent techniques in surgery of aortic aneurysm (wiring with electrocoagulation,[6] resection with grafting,[8] by-pass grafting,[13] and excision of the sac[2]) are facilitated if exact information concerning the location, origin, and length of the aneurysm is available. This information can best be obtained by translumbar arteriography. Arteriography is also important in evaluating the operative results.

Figure 1 illustrates an aneurysm of the distal aorta with extension into the right common iliac artery. Because of the location and extent of the lesion as shown on the arteriogram, cellophane wrapping was performed instead of excision and grafting.

Renal Artery. Aneurysms of the renal artery are quite rare, being encountered in only 0.01 per cent of autopsies.[30] They usually contain calcium, in which case the diagnosis can ordinarily be made roentgenologically without resorting to arteriography. At times, localization of the calcific density may be uncertain, and arteriography may be indicated.[1,31,33] A noncalcified aneurysm of an intrarenal branch of the renal artery was found in 1 case in the present series.

Splenic Artery. Aneurysms of the splenic artery are encountered in about 0.04 per cent of autopsies. Calcification is quite common, and when it occurs the diagnosis can usually be established by appropriate roentgen studies, without recourse to arteriography.[30] Noncalcified splenic artery aneurysms have occasionally been demonstrated by arteriography.[35]

We have encountered a number of cal-

* From the Department of Radiology, University of Cincinnati College of Medicine and Cincinnati General Hospital. Presented at the Fifty-fourth Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Sept. 29–Oct. 2, 1953.

Fig. 1. Female, aged sixty-five. Aneurysm of distal abdominal aorta extending into right common iliac artery, confirmed at operation. The location and extent of the aneurysm and the poor condition of the patient precluded excision and grafting. Cellophane wrapping was performed.

cified splenic artery aneurysms on abdominal roentgenograms, but arteriography was performed in only 1 of these, previously reported.[32] In addition, a noncalcified aneurysm was observed as an incidental finding in 1 case.

Hepatic Artery. Aneurysm of the hepatic artery is rare, only 96 cases having been reported.[4,18] The majority of these cases exhibited signs of common duct obstruction, gastrointestinal hemorrhage, or hemoperitoneum. The diagnosis has not been made prior to operation or autopsy. A calcified aneurysm of an accessory hepatic artery was identified by arteriography in 1 case, and confirmed at operation (Fig. 2).

Iliac Artery. Aneurysm of the common iliac artery or one of its branches may be associated with peripheral vascular symptoms and impaired femoral pulsations. Arteriography performed for the purpose of demonstrating iliac thrombosis may reveal aneurysm instead. More commonly there is fusiform rather than saccular dilatation. Figure 3 illustrates aneurysmal dilatation of both iliac arteries in a patient with poor femoral pulsations bilaterally.

ARTERIOVENOUS FISTULA

Arteriovenous fistula can usually be diagnosed clinically. However, arteriography may be of considerable assistance to the surgeon by delineating the vessels involved and the size and number of communications.[17,24]

We have been given the opportunity of studying translumbar arteriograms in 3 cases of traumatic femoral arteriovenous

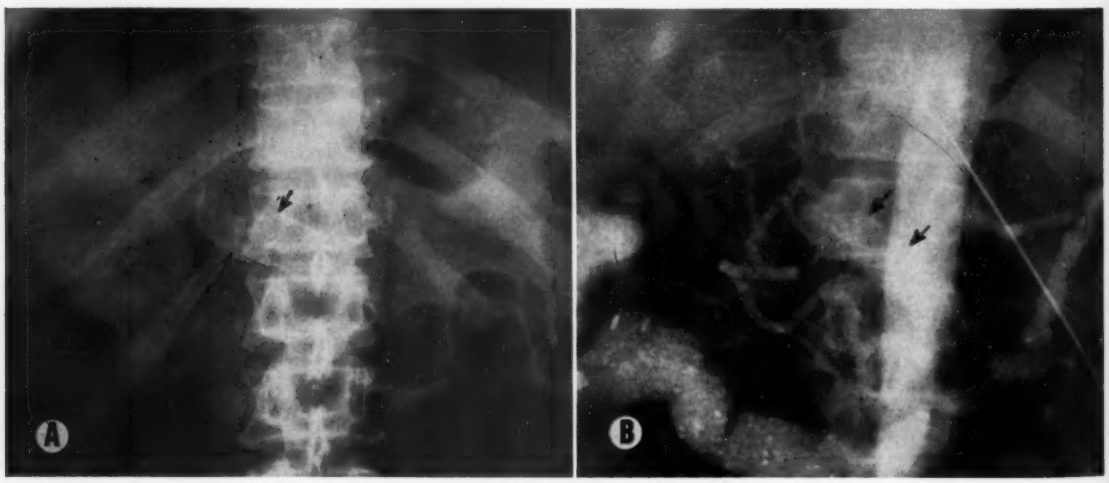


Fig. 2. Male, aged sixty. Calcified aneurysm of an accessory hepatic artery (arrows) arising directly from the aorta. (*A*) Plain film of the abdomen. (*B*) Translumbar arteriogram showing contrast medium filling the aneurysm. The diagnosis was confirmed at operation.

Fig. 3. Male, aged seventy-four. Aneurysmal dilatation of both common iliac arteries. Femoral pulses were barely palpable bilaterally.

Fig. 4. Male, aged twenty-eight. Arteriovenous fistula following closure of a traumatic perforation of the left femoral artery. The fistula (middle arrow) connects the femoral artery and vein. Upper arrow indicates the external iliac artery and vein, lower arrow the femoral artery in the thigh.

fistula through the kindness of Dr. Joseph L. Morton, of Columbus, and Dr. Everett L. Pirkey and Dr. David Shapiro, of Louisville. In each of these cases the abnormal communication between the femoral artery and vein was visualized and the dilated and tortuous collateral arteries and veins were clearly shown (Fig. 4).

A small hemangioma of the liver was an incidental finding in 1 of our cases (Fig. 5). Small hepatic hemangiomas are quite often discovered at autopsy, and larger ones are occasionally palpable clinically.

Arteriovenous communications and hemangiomas occasionally occur in other viscera[19] and should be demonstrable by translumbar arteriography.

THROMBOSIS

Aortic. Thrombotic occlusion of the distal aorta is not uncommon, the autopsy incidence being approximately 0.1 per cent.[3] The condition is most frequently found among young adult males. Arteriosclerosis plays a considerable role in its development, although occasionally inflammatory arteritis, thromboangiitis obliterans, syphilis, and trauma have been implicated.[5]

The thrombosis is said to begin most often in one common iliac artery and to extend proximally to involve the aorta and opposite common iliac. However, it sometimes arises in the aorta itself. The thrombus propagates slowly, permitting the development of considerable collateral circulation.[5,7]

Leriche[23] first described the clinical syndrome which now bears his name. Signs and symptoms of peripheral vascular disease are usually present. Hypertension confined to the upper extremities and a history of unstable erections are common, but not invariable, findings. The clinical diagnosis can usually be made by noting the absence of pulsation over the femoral arteries and

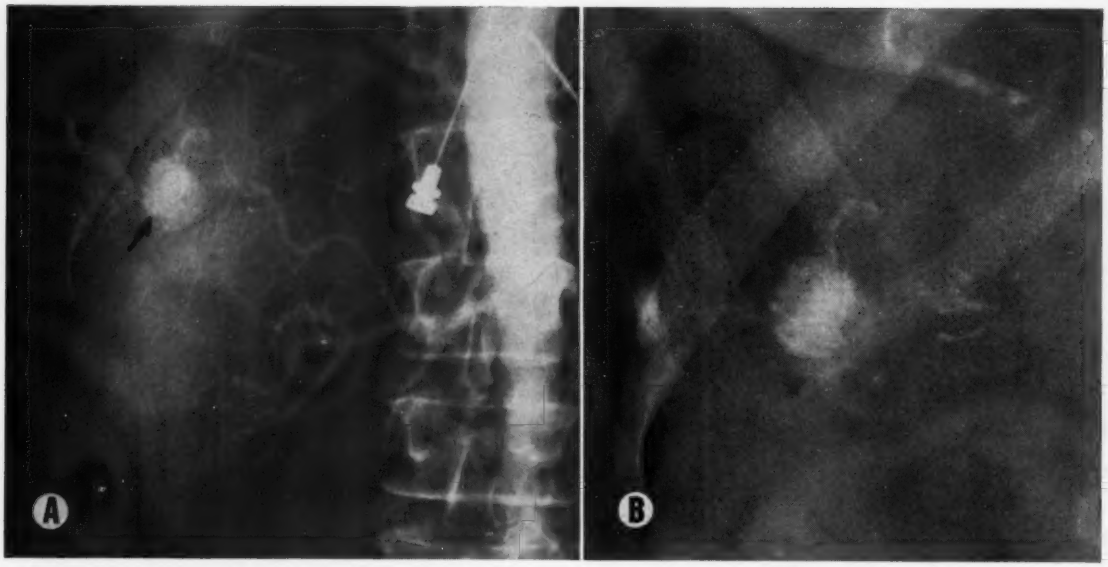


Fig. 5. Female, aged fifty-eight. (*A*) Small hemangioma of the liver (arrow) filling from the right hepatic artery. (*B*) Film made five seconds later shows retention of contrast medium in the hemangioma.

lower abdominal aorta.[10,25,26] The average duration of symptoms is seven years. If untreated, death ultimately occurs from complications of hypertension, from gangrene of the lower extremities, or, rarely, from extension of the thrombus above the renal arteries.

Surgery has given encouraging results in controlling the disease. Although sympathectomy has not been as effective alone as when combined with resection of the involved segment, performance of the latter procedure is not always possible.[10,26] More recently thromboendarterectomy[37] and resection with grafting[28] have been recommended.

Translumbar arteriography has frequently been used to establish the diagnosis. Of equal importance, however, is that it aids the surgeon in selecting and planning the operative procedure.[11] Extension of the thrombus to the vicinity of the orifices of the renal arteries is a contraindication to resection. Marked arteriosclerotic involvement proximal to the aortic obstruction makes ligation or grafting difficult or impossible. The extent of the collateral circulation may be of prognostic importance. This information is readily obtained by arteriography.

The arteriogram (Fig. 6) is easily interpreted. The proximal level of the obstruction in relation to the major branches of the aorta is noted. The state of the aortic wall is determined by the degree of irregularity of its margins and by the width of the column of contrast medium proximal to the thrombus. The collateral pathways vary with the location of the thrombus. The anastomotic channel between the middle colic branch of the superior mesenteric artery and the left colic branch of the inferior mesenteric artery is commonly present, and appears as a single wavy vessel meandering through the left abdomen. The lower intercostals are often visualized as dilated tortuous vessels anastomosing inferolaterally with the deep circumflex iliac branches of the external iliacs. The collateral channels connecting the lumbar arteries with the deep circumflex iliac and iliolumbar arteries are frequently seen in the paravertebral region. Less commonly visualized are the collaterals between the superior and the inferior epigastric arteries and those joining the sigmoidal and hemorrhoidal branches of the inferior mesenteric artery with the hemorrhoidal branches of the hypogastrics.

Saddle embolism of the aortic bifurcation

has been demonstrated by translumbar arteriography,[24,31] but emergency operation for this condition ordinarily should not be delayed for the performance of arteriography.

Renal Artery. Complete occlusion of a main renal artery is not rare, and we have demonstrated it a number of times by translumbar arteriography (Fig. 7). However, we have encountered several cases in which one or both renal arteries failed to fill on technically adequate arteriograms, despite the absence of clinical or pyelographic evidence of renal artery occlusion. The diagnosis of renal artery thrombosis can be made with greater assurance when a kidney exhibits complete loss of excretory function in the presence of normal ureter, pelvis, and calyces as revealed by the retrograde pyelogram.

Fig. 6. Female, aged thirty-seven. Thrombotic occlusion of the aorta. The arteriogram reveals aortic obstruction (*1*) extending almost to the level of the renal artery orifices, a relatively normal aorta proximal to this level, a tortuous anastomotic channel (*3*) between the superior (*2*) and inferior mesenteric arteries, and dilated tortuous lower intercostal arteries (*4*) connecting to branches of the deep circumflex iliacs. The patient had peripheral vascular symptoms and bilateral absence of femoral pulses.

Fig. 7. Male, aged sixty-six. Left renal artery occlusion. Intravenous pyelogram revealed absence of function of left kidney, but left retrograde pyelogram was normal. Translumbar arteriogram reveals normal right main renal artery (arrow) but absence of visualization of the left, confirming the diagnosis of left renal artery thrombosis. The patient had hypertension.

From this experience it is concluded that translumbar arteriography has little to offer in the diagnosis of complete occlusion of a renal artery. This statement does not apply to *partial* occlusion of the renal artery, or to complete occlusion of one of its branches. In the latter conditions, renal function is often normal despite the presence of infarcts, and arteriography may be the only means of establishing the diagnosis. In a previous communication[32] the arteriographic findings in 4 proved cases of renal infarction were described. In 2 cases no distinctive arteriographic features were noted. In the specimens, the infarcts were small and the occluded vessels peripherally located. The third case revealed abrupt termination of several of the smaller renal artery branches, associated with localized depressions in the renal outline overlying these vessels. The fourth case showed almost complete occlusion of the left main renal artery with only a single branch entering the kidney.

Iliac Artery. Loose[27] states that thrombosis of a common iliac artery or one of its major divisions occurs in about 35 per cent of patients with peripheral arterial disease.

In iliac thrombosis the signs and symptoms of peripheral vascular disease are present and there is usually absent femoral pulsation. The condition sometimes occurs bilaterally and then may simulate aortic thrombosis.

Various surgical procedures have been utilized in treating this condition, including sympathectomy, thromboendarterectomy,[22,36] and resection with arterial or venous grafting.[20,24] There has been considerable recent progress in this field of surgery.

The final selection of patients for surgery and the type of operation to be performed depend on the location and extent of the arterial obliteration, the status of the arterial wall proximal and distal to the thrombus, the amount of collateral circulation, and, most important, the demonstration of refilling of the distal portion of the main arterial channel by the collaterals.[20,27] Only arteriography provides all this essential information.

The presence of numerous irregular defects in the artery above and below the thrombus signifies severe disease in the arterial wall which makes grafting technically difficult (Fig. 8). The absence of distal filling of the main channel indicates that a distal vessel suitable for anastomosis probably will not be found (Fig. 9). The demonstration of multiple occlusions usually means that definitive surgery is impractical.

Occasionally, clinical findings consistent with iliac thrombosis are associated with the arteriographic demonstration of severe arterial disease with patent but attenuated lumens. Direct surgery of these arteries is not feasible in such cases.[20]

In Buerger's disease extensive thromboses, relatively normal arterial walls, minimal collateral circulation, and failure of refilling of the main artery are said to occur.[24] Since arterial surgery is not indicated, arteriography has little practical value in this disease at the present time. As experience increases, however, arteriography may prove helpful in the diagnosis of Buerger's disease.

Translumbar arteriography is preferable to other methods of arteriography (catheter, counter-current, and femoral arteriog-

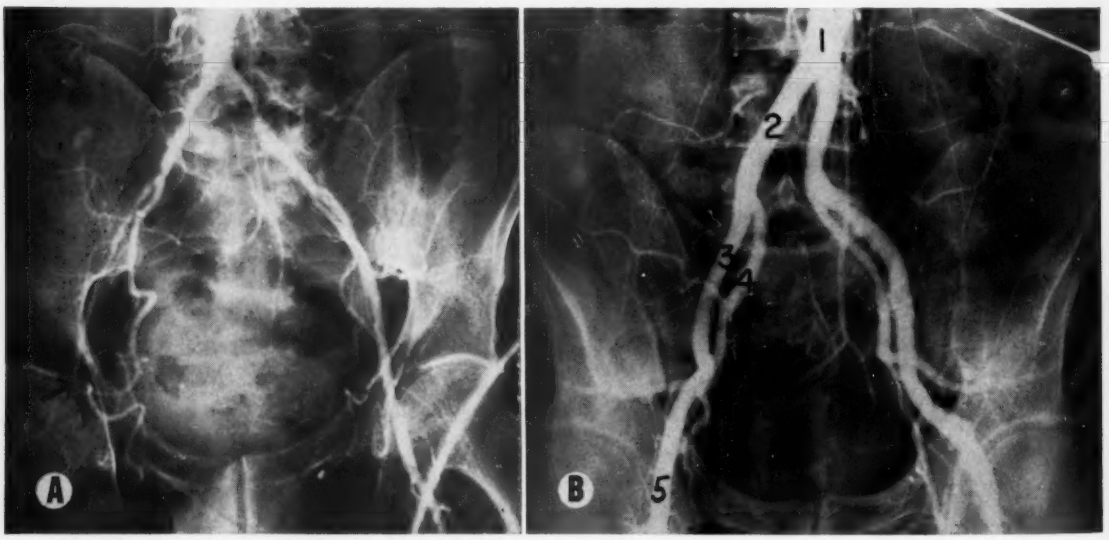


Fig. 8. Male, aged seventy. Femoral artery thrombosis. (*A*) The right femoral artery is blocked (arrow) at its junction with the external iliac artery. Note the marked irregular narrowing of both common iliacs and the right external iliac artery. The right femoral pulse was absent and the left was diminished. (*B*) Normal translumbar arteriogram for comparison (courtesy of Dr. Joseph L. Morton). (*1*) Aorta; (*2*) common iliac; (*3*) external iliac; (*4*) hypogastric; (*5*) femoral.

Fig. 9. Male aged sixty. Common iliac artery thrombosis. The left common iliac is obstructed at the aortic bifurcation (circle). The left hypogastric fills from collaterals of the inferior mesenteric and sacral arteries. The left external iliac and femoral arteries did not fill on any films in the series, although collaterals were visualized in the left thigh. The left femoral pulse was absent.

raphy) in the demonstration of thrombosis of the aorta and iliac arteries. With the latter procedures, the risk of inducing vasospasm in an already diseased limb is said to be greater,[34] and information concerning the status of the vessel proximal to the block is not obtained. The catheter methods are also more time consuming, in our experience.

Excellent arteriograms of the thigh and leg can be obtained by aortic injection (Fig. 10). Certain modifications of the conventional abdominal arteriographic technique are necessary. The aortic puncture is made at a lower level, usually at the third lumbar vertebra. Larger quantities of contrast medium (about 30 cc.) are injected. A tourniquet applied to the normal extremity may also be helpful. Serial films at about one second intervals are desirable but not essential.

RENAL HYPERTENSION

Goldblatt and his co-workers[14] found that constriction of one main renal artery resulted in transient hypertension in the dog, and more prolonged hypertension in certain other animals. Constriction of both renal arteries produced persistent hypertension, as did constriction of one renal artery and removal of the opposite kidney. Excision of the ischemic kidney following unilateral constriction resulted in the disappearance of hypertension.

Fig. 10. Male, aged sixty-seven. Femoral artery thrombosis in thigh demonstrated by translumbar arteriography. The left femoral artery is blocked at the level of the profunda femoris (upper arrow). There is refilling of the popliteal artery via collaterals (lower arrow). The left popliteal pulse was absent.

These classical experiments immediately raised the hope that hypertension associated with unilateral kidney disease might

be benefited or cured by removing the diseased kidney. This proved to be true in relatively few patients, most of whom had unilateral chronic pyelonephritis with intrarenal stenosing vascular disease. However, case reports of hypertension resulting from unilateral involvement of the *main* renal artery, by embolism, thrombosis, aneurysm, or pressure from an extrinsic mass, though not numerous, seem authentic.[9,16,21]

Bilateral main renal artery involvement has not been so well documented as a cause of human hypertension.[12,29] Goldblatt, Kahn and Lewis[15] encountered patients with hypertension who at autopsy showed stenosis of the mouth of each renal artery by arteriosclerotic plaques or thrombosis, and in whom the intrarenal vessels were essentially normal. They remarked, "If such conditions could be recognized in life, treatment by production of accessory renal circulation might be successful."

Fig. 11. Female, aged thirty-seven, with malignant hypertension. Renal function tests, urinalysis, and pyelography were normal. Arteriogram shows narrow segment in the right main renal artery (arrow) and a localized constriction with post-stenotic dilatation in the left renal artery.

The case shown in Figure 11 (reported through the courtesy of Drs. L. G. Herrmann and A. J. Gabriele) appears to fulfill these conditions. Bilateral constriction of both renal arteries was clearly demonstrated on the arteriogram. Unfortunately, the patient died of malignant hypertension before contemplated surgery (splenorenal arterial anastomosis) could be carried out. Autopsy revealed marked arteriosclerotic constriction of the right main renal artery, but the stenosis on the left was not well defined.

This case represents the only one among our series of approximately 75 hypertensives that showed involvement of either main renal artery on arteriography. We have seen unilateral constriction of a renal artery unassociated with hypertension in 2 cases. This experience is borne out by the paucity of reports of positive arteriographic findings in hypertensives recorded in the literature, and is in agreement with Goldblatt's conviction that human hypertension is much less commonly related to constriction of the main renal artery than to disease of the intrarenal vessels. In the latter group, the affected intrarenal branches are too small to be depicted by present arteriographic techniques.

For these reasons we believe that abdominal arteriography seldom provides information of importance in the diagnosis or management of renal hypertension and that our present state of knowledge does not warrant its routine use in such cases.

SUMMARY AND CONCLUSIONS

The literature on translumbar arteriography offers convincing evidence that the abdominal aorta and its branches can be visualized consistently and with reasonable safety, often yielding important information obtainable in no other manner. This is supported by personal experience with a large series of cases. Even when other methods result in a correct diagnosis of the vascular condition, arteriography may afford additional information which is important in its management. This is particu-

larly true in the expanding field of arterial surgery, where arteriography often guides the surgeon in his selection of cases, choice of methods, and planning of the operative procedure. In a few areas where it was initially hoped that arteriography might be of great importance, notably in the diagnosis of the Goldblatt kidney, it has proved disappointing.

Thus, translumbar arteriography is of value in the diagnosis and treatment of thrombosis and aneurysm of the aorta and iliac arteries, arteriovenous fistula, and in renal infarction. It is seldom indicated in calcified aneurysm of the renal or splenic artery, thrombotic occlusion of the main renal artery, saddle embolism of the aorta, and hypertension.

On the whole, abdominal arteriography can now be accepted as a reliable diagnostic implement and therapeutic guide in arterial disease of the abdominal aorta and its branches.

Department of Radiology
Cincinnati General Hospital
Cincinnati 29, Ohio

Grateful acknowledgment is extended to Drs. Edward C. Elsey, Arthur T. Evans, A. J. Gabriele, Louis G. Herrmann, Joseph L. Morton, Everett L. Pirkey, and David Shapiro for permission to review their case material. Thanks are also due Drs. David Abramson, John J. Cranley, Jr., Emanuel J. Levin, and Martha Southard for their assistance in assembling the material and preparing the manuscript.

REFERENCES

1. Abeshouse, B. S. Aneurysm of renal artery; report of 2 cases and review of literature. *Urol. & Cutan. Rev.*, 1951, *55*, 451–463.
2. Bahnson, H. T. Definitive treatment of saccular aneurysms of aorta with excision of sac and aortic suture. *Surg., Gynec. & Obst.*, 1953, *96*, 383–402.
3. Barnett, W. E., Moorman, W. W., and Merrick, B. A. Thrombotic obliteration of abdominal aorta: report of six cases. *Ann. Int. Med.*, 1952, *37*, 944–965.
4. Barnett, W. O., and Wagner, J. A. Aneurysm of hepatic artery—cause of obscure abdominal hemorrhage. *Ann. Surg.*, 1953, *137*, 561–564.
5. Beaconsfield, P., and Kunlin, J. Insidious thrombosis of aortic bifurcation; report of thirty-five cases. *Arch. Surg.*, 1953, *66*, 356–364.
6. Blakemore, A. H. Progressive constrictive occlusion of abdominal aorta with wiring and electrothermic coagulation; one-stage operation for arteriosclerotic aneurysms of abdominal aorta. *Ann. Surg.*, 1951, *133*, 447–462.
7. Boyd, W. M. Thrombosis of terminal aorta with aortitis and periaortitis. Report of 2 cases treated by aortectomy, lumbar sympathectomy, and vena caval ligation. *Rocky Mountain M. J.*, 1950, *47*, 936–943.
8. De Bakey, M. E., and Cooley, D. A. Successful resection of aneurysm of thoracic aorta and replacement by graft. *J.A.M.A.*, 1953, *152*, 673–676.
9. Duff, G. L., and Murray, E. G. D. Obstructive lesions of main renal artery in relation to hypertension. *Am. J. Med. Sc.*, 1944, *207*, 394–404.
10. Elkin, D. C., and Cooper, F. Surgical treatment of insidious thrombosis of aorta; report of 10 cases. *Ann. Surg.*, 1949, *130*, 417–427.
11. Elliott, R. V., and Peck, M. E. Thrombotic occlusion of aorta as demonstrated by translumbar aortograms. *J.A.M.A.*, 1952, *148*, 428–431.
12. Freeman, G., and Hartley, G., Jr. Hypertension in a patient with a solitary ischemic kidney, *J.A.M.A.*, 1938, *111*, 1159–1162.
13. Freeman, N. E., and Leeds, F. H. Vein inlay graft in treatment of aneurysms and thrombosis of abdominal aorta; preliminary communication with report of 3 cases. *Angiology*, 1951, *2*, 579–587.
14. Goldblatt, H. The Renal Origin of Hypertension. Charles C Thomas, Publisher, Springfield, Ill., 1948.
15. Goldblatt, H., Kahn, J. R., and Lewis, H. A. Studies on experimental hypertension; experimental observations on treatment of hypertension. *J.A.M.A.*, 1942, *119*, 1192–1201.
16. Goodman, H. L. Malignant hypertension with unilateral renal-artery occlusion. *New England J. Med.*, 1952, *246*, 8–12.
17. Goodwin, W. E., Scardino, P. L., and Scott, W. W. Translumbar aortic puncture and retrograde catheterization of aorta in aortography and renal arteriography. *Ann. Surg.*, 1950, *132*, 944–958.
18. Grant, J. L., Fitts, W. T., Jr., and Ravdin, I. S. Aneurysm of hepatic artery; report of 2 cases and consideration of surgical treatment. *Surg., Gynec. & Obst.*, 1950, *91*, 527–532.
19. Hamilton, G. R., Getz, R. J., and Jerome, S. Arteriovenous fistula of renal vessels; case report and review of literature. *J. Urol.*, 1953, *69*, 203–207.
20. Julian, O. C., Dye, W. S., Olwin, J. H., and Jordan, P. H. Direct surgery of arteriosclerosis. *Ann. Surg.*, 1952, *136*, 459–474.
21. Laforet, E. G. Malignant hypertension associ-

ated with unilateral renal artery occlusion: three cases. *Ann. Int. Med.*, 1953, *38*, 667–688.

22. LeFevre, F. A., Phalen, G. S., and deWolfe, V. G. Intermittent claudication of hip. *Cleveland Clin. Quart.*, 1953, *20*, 375–380.
23. Leriche, R. De la résection du carrefour aorticoiliaque avec double sympathectomie lombaire pour thrombose artéritique de l'aorte; le syndrome de l'oblitération termino-aortique par artérite. *Presse méd.*, 1940, *48*, 601–604.
24. Leriche, R., Beaconsfield, P., and Boely, C. Aortography: its interpretation and value; report of 200 cases. *Surg., Gynec. & Obst.*, 1952, *94*, 83–90.
25. Leriche, R., Kunlin, J., and Boely, C. Lessons of aortography. *Angiology*, 1950, *1*, 109–132.
26. Leriche, R., and Morel, A. Syndrome of thrombotic obliteration of aortic bifurcation. *Ann. Surg.*, 1948, *127*, 193–206.
27. Loose, K. E. Die Aortographie in der Diagnostik peripherer Gefässleiden. *Chirurg.*, 1951, *22*, 394–398.
28. Oudot, J., and Beaconsfield, P. Thrombosis of aortic bifurcation treated by resection and homograft replacement; report of five cases. *Arch. Surg.*, 1953, *66*, 365–374.
29. Price, R. K., and Skelton, R. Hypertension due to syphilitic occlusion of main renal arteries. *Brit. Heart J.*, 1948, *10*, 29–33.
30. von Ronnen, J. R. Roentgen diagnosis of calcified aneurysms of splenic and renal arteries. *Acta radiol.*, 1953, *39*, 385–400.
31. Shapiro, D. Abdominal arteriography. *Radiology*, 1953, *60*, 1–17.
32. Smith, P. G., Evans, A. T., Elsey, E. C., and Felson, B. Translumbar arteriography: its roentgenologic interpretation. Am. J. Roentgenol., Rad. Therapy & Nuclear Med., 1952, *67*, 183–196.
33. Wagner, F. B., Jr. Arteriography in renal diagnosis. *J. Urol.*, 1946, *56*, 625–635.
34. Wagner, F. B., Jr. Present status of arteriography of peripheral vessels. *Angiology*, 1951, *2*, 499–516.
35. Wagner, F. B., Jr., Price, A. H., and Swenson, P. C. Abdominal arteriography; technique and diagnostic application. Am. J. Roentgenol. & Rad. Therapy, 1947, *58*, 591–598.
36. Wylie, E. J. Thromboendarterectomy for arteriosclerotic thrombosis of major arteries. *Surgery*, 1952, *32*, 275–292.
37. Wylie, E. J., Kerr, E., and Davies, O. Experimental and clinical experiences with use of fascia lata applied as graft about major arteries after thrombo-end-arterectomy and aneurysmorrhaphy. *Surg., Gynec. & Obst.*, 1951, *93*, 257–272.

Discussion of Papers by Evans, Rigler and Olfelt, and Felson

Dr. Paul C. Swenson, Philadelphia, Pennsylvania. The papers to which we have listened today have to do with an ever increasingly popular procedure. There can be no question that the use of vascular radiopaque media have done much to increase our knowledge of the anatomy, physiology and pathology of the abdominal viscera and their vascular supply. I am sure that we are going to see an ever increasing use of these procedures as our techniques improve. The essayists are all to be congratulated on the very fine demonstration of their work in a very difficult and relatively new field.

On observing some of the work in Europe this past summer, particularly in Scandinavia, I was impressed with some of the results that they had obtained with this procedure. Their serial anatomic studies following arteriography were amazing. The studies were carried out through a series of rapid roentgen-ray exposures—some taken as fast as 5 to 6 per second. When this can be accomplished, there has to be little concern about how, when and where the opaque material was injected. Indeed, I saw some series of 20 films made in this manner where the contrast medium had been injected through the arm vein after which either angiocardiography or abdominal aortography, as well as visualization of the liver, spleen and kidneys was accomplished. This, of course, makes the differential timing less important.

The current story, as far as diagnostic roentgenology is concerned, is that of new and better contrast media and new and better administration of the same. The splenic vein is now being visualized by direct injections through the abdominal wall into the spleen. The biliary tract is being attacked from without by direct injection into the gallbladder, and more and more the various radiopaque media are being injected with the patient on the operating table into certain exposed organs. Serial films have made it possible to follow the medium through the routes of absorption and excretion.

All these procedures have a real place once the indications are carefully considered. They are not to be used promiscuously, but, when indicated, they are really important.

I would like to discuss the problem of demonstrating metastatic tumors to the liver. There may be reason to question the conclusions of

Drs. Rigler and Olfelt in regard to the opacification or nonopacification of tumor masses. Recently Dr. John Healy of the Daniel Baugh Institute of Anatomy at Jefferson Hospital has been injecting autopsy specimens of the liver. He has encountered a number with metastatic nodules. They were all adenocarcinomas. When vinylite injections were made in these cases, the metastatic nodules were shown to be directly supplied by branches of the hepatic arteries and there was an extensive vascular rosette about each nodule, with well defined arterial branches penetrating the nodule itself. He has also injected the portal circulation in these cases and in no instance was there any connection shown in these cases with the metastatic areas. The ductal systems were displaced by metastatic nodules, but did not enter them.

Segall[1] reported 3 cases examined by essentially the same technique and he got the same results as Dr. Healy[2] achieved. Mann, Wakim and Baggenstoss[3] also report 2 cases. Bierman[4] *et al.* reported an increased vascularity about neoplasms in the liver in 4 of 5 cases with liver metastasis. In the fifth patient distortion of the vessels was apparent. This work was done on live patients following catheterization of the celiac axis.

It is our belief, based on the above findings, that the percentage of metastatic nodules which will show a vascular sludge should be rather high, particularly if the opaque material is injected directly into the celiac axis.

One more point should be mentioned in regard to the essayists' indications for the performance of hepatography in the case of suspected neoplasms. I think a third and most important indication should be that since a solitary metastasis is occasionally resectable, providing the damage to the blood supply will not be so extensive that too large a portion of the hepatic tissue will have to be sacrificed, one can then become familiar with the normal anatomy of the hepatic artery. One can determine from a hepatic arteriogram not only the presence of a solitary metastasis, but also the artery which supplies that portion of the liver in question and thus determine the feasibility of resection.

Our work as radiologists is becoming highly specialized, as these three presentations have demonstrated. The practical value of all three procedures has been shown.

I think we should conclude this fine symposium on a note of caution. One should always mention the possible harm of any new procedure. Therefore, I would urge that the possibility of a reaction to the radiopaque medium that is used be considered in every case and everything possible done to safeguard the patient in this respect. Sometimes when there is a history of allergy or sensitivity to a drug, there is often the necessity for deciding whether the benefit of the procedure is worth the possible hazard, keeping the comfort and welfare of the patient in mind at all times. Dr. Evans implies that there is an adequate test of sensitivity. In my experience there is no reliable test. I have had two nearly fatal reactions to radiopaque media—one from a test dose, so-called, and one with a negative skin reaction. I also have seen cases get along well when the reactions to the tests were positive.

Dr. Rigler (closing). I will make a few comments, especially since Dr. Swenson directed some questions to my paper.

At the outset, before I forget, may I say that Dr. Miller warned me to warn you (and I think quite rightly) that in any such procedure as we have discussed, in which the serial films are going to be made or quite a number of films are going to be made, every precaution must be taken to prevent radiation hazard. I don't need to elaborate upon that at all. I am sure you are all aware of it, but I would like to emphasize it. It is very easy to overlook, especially with a urologist carrying out most of the technique.

I wish we had a syringe such as Dr. Kjellberg described the other day, so we could inject the 40 cc. of urokon more rapidly. Those of you who saw the last films Dr. Felson showed will get some idea of the difference in the appearance of the aortogram when the injection is made low, and with a small amount, as contrasted to those which I showed.

I would point out that there was a purpose in going high, the purpose being partly stimulated by the fact that a case or two has been reported

[1] Segall, H. N. Experimental anatomical investigation of blood and bile channels of liver. *Surg., Gynec. & Obst.*, 1923, *37*, 152–178.

[2] Healy, J. E. Personal communication.

[3] Mann, J. D., Wakim, K. G., and Baggenstoss, A. H. Vasculature of human liver; study by injection-cast method. *Proc. Staff Meet., Mayo Clin.*, 1953, *28*, 227–232.

[4] Bierman, H. R., Miller, E. R., Byron, R. L., Dod, K. S., Kelly, K. H., and Black, D. H. Intra-arterial catheterization of viscera in man. Am. J. Roentgenol. & Rad. Therapy, 1951, *66*, 555–568.

in which canalization with actual introduction of the contrast medium directly into the celiac axis had been made with some unfortunate results; by going higher one avoids that possibility.

With regard to the question of metastases, you will recall that I showed one injection. Dr. Lewis has done a number of them. Apparently there seems to be some difference in our carcinomas from those in Philadelphia, because we haven't shown any good circulation extending into them; but I think it should be pointed out that the major portion of the contrast medium which goes to the liver that we are seeing is going through the portal circulation.

Our films are made late, not early. Therefore, it is not very important what the metastases do to the hepatic artery. What is important is what they do to the sinusoids. It is this that I think produces the defects in the contour.

I tried to show in the diagram from Rich that if you increase the size of the hepatic tissue around the sinusoids and occlude them, the circulation will be so slow that in a series of films made in about twenty seconds practically no opacification of the area will result. This at least has been our experience.

On the other hand, as I said earlier, we have had 2 cases in which we were unable to demonstrate metastases, and it is quite conceivable that in those cases there was not much compression of the sinusoids, and fairly good circulation going through the area. We considered that a strong possibility for the explanation of that difference.

One more point about the reactions to the opaque medium: I think it should be emphasized that when you inject contrast media in the abdominal aorta, the kind of reaction one gets with intravenous injections is usually not encountered or is extremely rarely encountered, and especially, of course, is that true if the patient is under anesthesia.

I think the usual systemic type of reaction, as far as I know, has never been encountered after this type of injection. On the other hand, there are some dangers in arteriography of the aorta. We have had one case that developed a transient (fortunately, but very frightening) transverse myelitis or evidences of a paraplegia following injection. We are quite confident that this was due to some very clumsy handling of the needle at the time, rather than to the contrast medium or to the rest of the procedure. That danger, I am sure, must always be borne in mind.

Vol. 72, No. 4

GASTRIC VOLVULUS

PART I

By CHARLES GOTTLIEB, M.D., DAVID LEFFERTS, M.D., *and* SAMUEL L. BERANBAUM, M.D.
University Hospital
NEW YORK, NEW YORK

ALTHOUGH gastric volvulus is a relatively rare condition and infrequently reported, it was described by Berti[3] as early as 1866. The early European authors studied this entity extensively from operative and autopsy material, illustrating their findings with accurate anatomical drawings.

In spite of this early beginning, there is a paucity of reports in the roentgen literature, even though position anomalies of the stomach have been thoroughly investigated. Rosselet,[28] in 1921, reported the first case to be observed roentgenographically, a case of total organo-axial volvulus, which was later found to be normal. The next year, together with Gilbert,[28] he reported another case of intermittent volvulus, in which the findings were demonstrated roentgenologically. Since then, other cases have been reported (Rhinehart and Rhinehart[25] in 1926 and later in 1936;[26] Kautz[15] in 1928; Azmy and Marey,[1] in 1932; Myles,[21] Shanks and Kerley,[29] and others). Singleton's[32] presentation in 1940 was one of the most extensive to date and was the first to use the term "chronic gastric volvulus" in the roentgen literature.

An analysis of these papers shows differences of opinion with respect to the etiology. Rhinehart and Rhinehart[25,26] review the abnormalities caused by the failure of descent of the stomach into the abdomen by congenital or development defects of the diaphragm, and by interruption of the phrenic nerve. They present their case as a simple inversion of the stomach with the theory, that, after the descent of the other viscera, the stomach must have changed end for end by rotation around a transverse axis below the dome of the diaphragm. Azmy and Marey report 2 cases which they describe as extreme forms of cascade stomach with complete torsion or volvulus around the longitudinal axis, one of the cases showing normal organic findings, the other a chronic duodenal ulcer. They came to the conclusion that this condition can be caused by long standing and excessive gaseous distention of the transverse colon (aerocoly). The colon is attached to the stomach by the gastrocolic omentum and is therefore carried upward and forward by the rotation of the greater curvature. Singleton's[32] paper gives an extensive classification of this condition, which will be mentioned later. He reports 3 cases of volvulus and concludes that this extremely rare condition can be assumed to be acquired.

Zimmerman[36,37,38] reports a case of volvulus around the transverse axis of the stomach. He connects this lesion with a misplaced spleen containing sclerosed vessels, and presents the theory that this condition has been acquired by the pulling effect of the formerly loose spleen. He attempts to prove this theory by experiments performed at several autopsies, showing that if the spleen were mobilized and traction exerted on the intact gastrosplenic ligament downward, downward and forward, or downward and medially, the corpus of the stomach came along for quite a distance and the esophagus became elongated. He assumes that with a large spleen, extensively mobile over a period of years, it is conceivable that the greater curvature of the stomach may be displaced and rotated upward and stay in that position due to repeated insults in the course of time.

In other words, there are several case reports of vovulus of the stomach shown by roentgen examination and several theories

concerning its etiology, with advocates for either its congenital or acquired origin.

In view of the confusion, and since operative or postmortem studies were meager in these analyses, a review of the surgical literature of the last decades was undertaken, where a much more extensive and detailed description was found, with reports of a larger number of cases. These papers include reports of all types, most of them being clinically different from the previously mentioned cases. However, they are of greater interest because of the anatomical conditions found during operations and autopsies, and the conclusions drawn therefrom. It is impossible to quote all the papers other than the most interesting. Berti,[3] as mentioned, in 1866 was the first to report on volvulus of the stomach. He described a forward and upward rotation of the entire stomach, with the exception of the subdiaphragmatic portion of the fundus, through an angle of 180 degrees, so that the greater curvature lay uppermost against the diaphragm. Von Haberer,[13] Kocher,[17] Läwen,[18] Neumann,[22] and Weeder[35], to mention a few, also contributed.

Payer[24] (1907) presents a classification of the etiology of volvulus which is reproduced with slight modifications.

1. Idiopathic volvulus
2. Secondary volvulus
   a. Hernia or eventration of the diaphragm
   b. Tumors of the stomach
   c. Inflammatory processes
   d. Peptic ulcer and/or hourglass stomach
   e. Postoperative conditions
   f. Displacement by neighboring organs including gravid uterus (v. Bondsorff)

A topographical classification has been forwarded by von Haberer[13] and is largely quoted by Singleton.[32] It is reproduced as the most satisfactory to date.

Volvulus of the Stomach:

I. Type:

(a) Organo-axial
   1. Supracolic
   2. Infracolic

Rotation of the stomach upward around the long axis of the stomach, i.e. around the coronal plane.

(b) Mesentero-axial

Rotation of the stomach from right to left, or left to right about the long axis of the gastrohepatic omentum (radix mesenterii).

II. Extent:

(a) Total—Cases in which the whole stomach except the diaphragmatic attachment rotates.

(b) Partial—Instances in which the rotation is limited to a segment of stomach, usually the pyloric end.

III. Direction:

(a) Anterior—Cases in which the rotating part passes forward.

(b) Posterior—Cases in which the rotating part passes backward.

IV. Etiology:

(a) Secondary to disease in the stomach or adjoining organs (see preceding classifications).

(b) Idiopathic

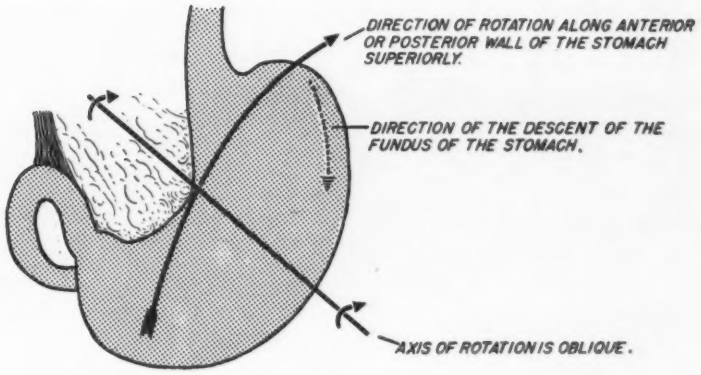
V. Severity:

(a) Acute—Presenting a picture of an acute abdomen.

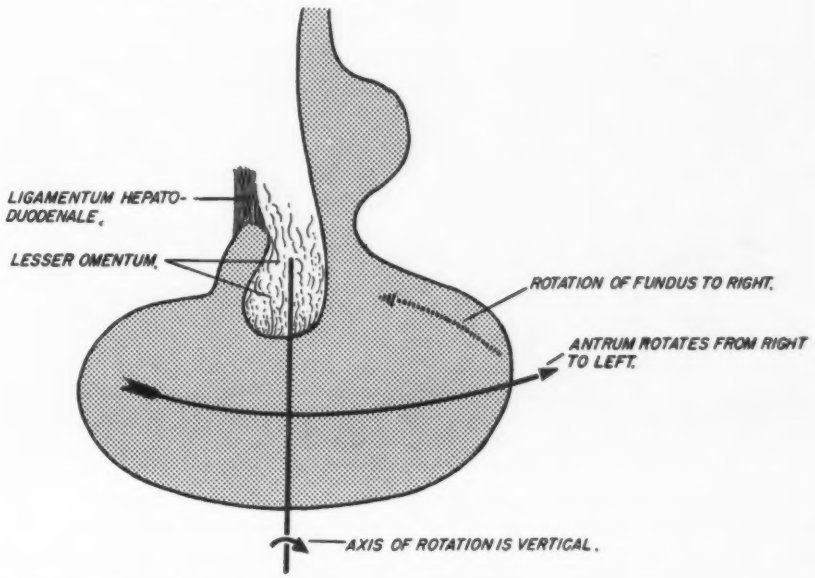
(b) Chronic—Causing constant or recurrent milder symptoms, or symptomless.

Borchardt[5] and Neumann[22] have largely contributed to the better understanding of the two different types by reproducing in their respective papers drawings, representing the demonstration of the conditions found in situ during operations, postmortem studies and experiments. The drawing of Borchardt shows the mesentero-axial, the one of Neumann the organo-axial type of volvulus. Both demonstrate the slow development of the volvulus as found in their experimental studies. In addition to these standard types there certainly are mixed types of volvulus as reported by Weeder,[35] and others. In reviewing the drawings of Borchardt[5] it is clear that, to understand this type of volvulus (mesentero-axial), a certain atony or lengthening of the peritoneal fixations, the gastrosplenic, gastrophrenic, hepatogastric, and gastroduodenal ligaments with more or less ptosis of the stomach, have to be present. On the other hand, Neumann shows that ptosis of the stomach is not a necessary prerequisite in his case, the organo-axial type.

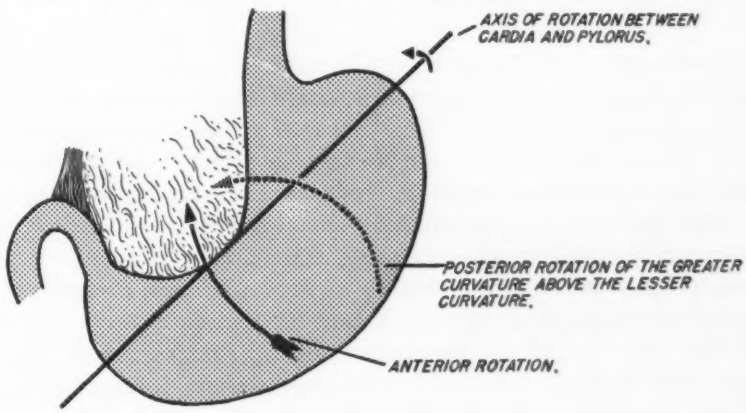
An important point in the mechanism of gastric volvulus is the role of the large in-


DIRECTION OF ROTATION ALONG ANTERIOR OR POSTERIOR WALL OF THE STOMACH SUPERIORLY.
DIRECTION OF THE DESCENT OF THE FUNDUS OF THE STOMACH.
AXIS OF ROTATION IS OBLIQUE.

A 1. MESENTERO-AXIAL VOLVULUS


LIGAMENTUM HEPATO-DUODENALE.
LESSER OMENTUM.
ROTATION OF FUNDUS TO RIGHT.
ANTRUM ROTATES FROM RIGHT TO LEFT.
AXIS OF ROTATION IS VERTICAL.

A 2. 2ND. TYPE WITH MARKED PTOSIS OF THE STOMACH


AXIS OF ROTATION BETWEEN CARDIA AND PYLORUS.
POSTERIOR ROTATION OF THE GREATER CURVATURE ABOVE THE LESSER CURVATURE.
ANTERIOR ROTATION.

B. ORGANO-AXIAL VOLVULUS

FIG. 1. (*A1*) Mesentero-axial volvulus with stomach in usual position. (*A2*) Mesentero-axial volvulus with marked ptosis of the stomach. (*B*) Organo-axial volvulus with either anterior or posterior rotation of the greater curvature above the lesser curvature.

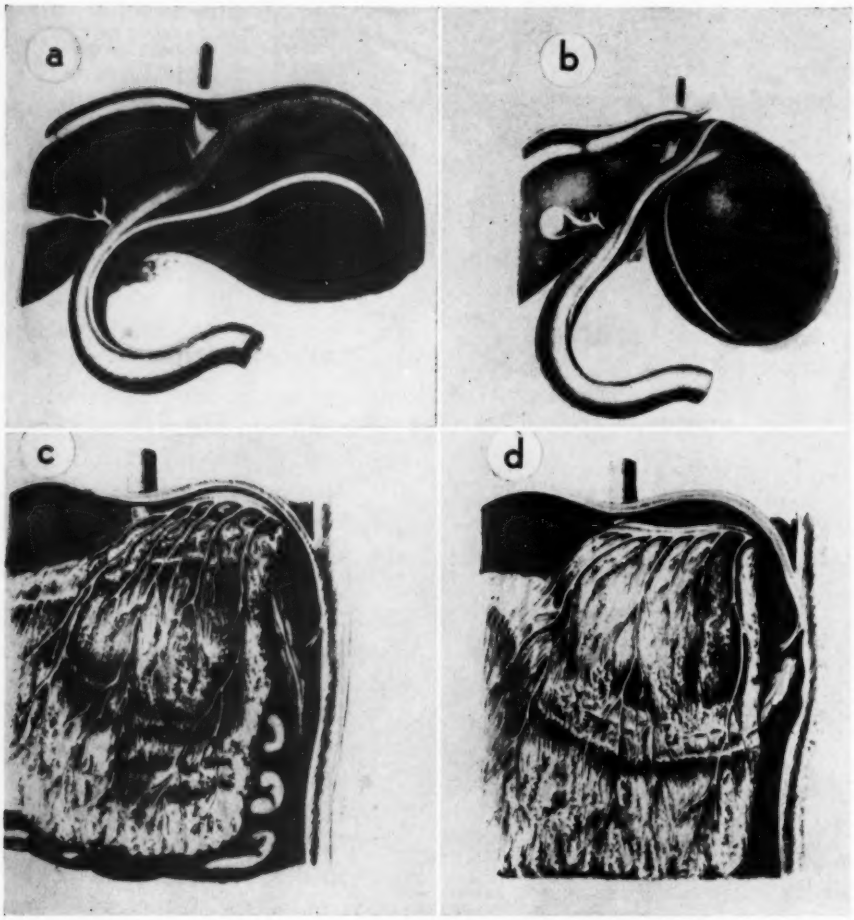


FIG. 2. Drawings reproduced from Borchardt.[5] Mesentero-axial volvulus: (*a*) The initial phase of rotation. The fundus of the stomach, as the greater curvature ascends, starts to roll along the posterior wall of the abdomen from left to right. (*b*) Shows the complete volvulus, the posterior wall of the stomach being anterior, the greater curvature downward, pylorus and cardia being close to each other. (*c*) (*d*) Demonstrate the infracolic and supracolic type of volvulus with the mesentery in the normal position. The mesentery is not illustrated in (*a*) and (*b*) for purposes of clarity.

testine, or more precisely, of the transverse colon. Borchardt[5] in 1904, after having operated on a 180 degree volvulus of the stomach without the participation of the transverse colon in the rotation process, suggested the subdivision into supracolic and infracolic types. The anatomical relation between the greater curvature of the stomach and the transverse colon through the gastrocolic ligament causes a certain coordination of their movements. If the greater curvature rotates upward, the transverse colon will likewise be forced to ascend. The more the greater curvature rotates, the more the transverse colon will be pulled upward until it finally is above the level of the stomach, the stomach having rotated at least 180 degrees. This is the infracolic type, very rarely reported. This process is likely to happen in cases with a normal or with a relatively short omental attachment.

There are cases, however, where the position of the transverse colon remains unchanged, that is, below the level of the rotated stomach. Von Haberer[13] believes that, in the mechanism causing volvulus of the stomach, there are forces overcoming the fixation of the greater curvature, which to a certain degree is kept in normal posi-

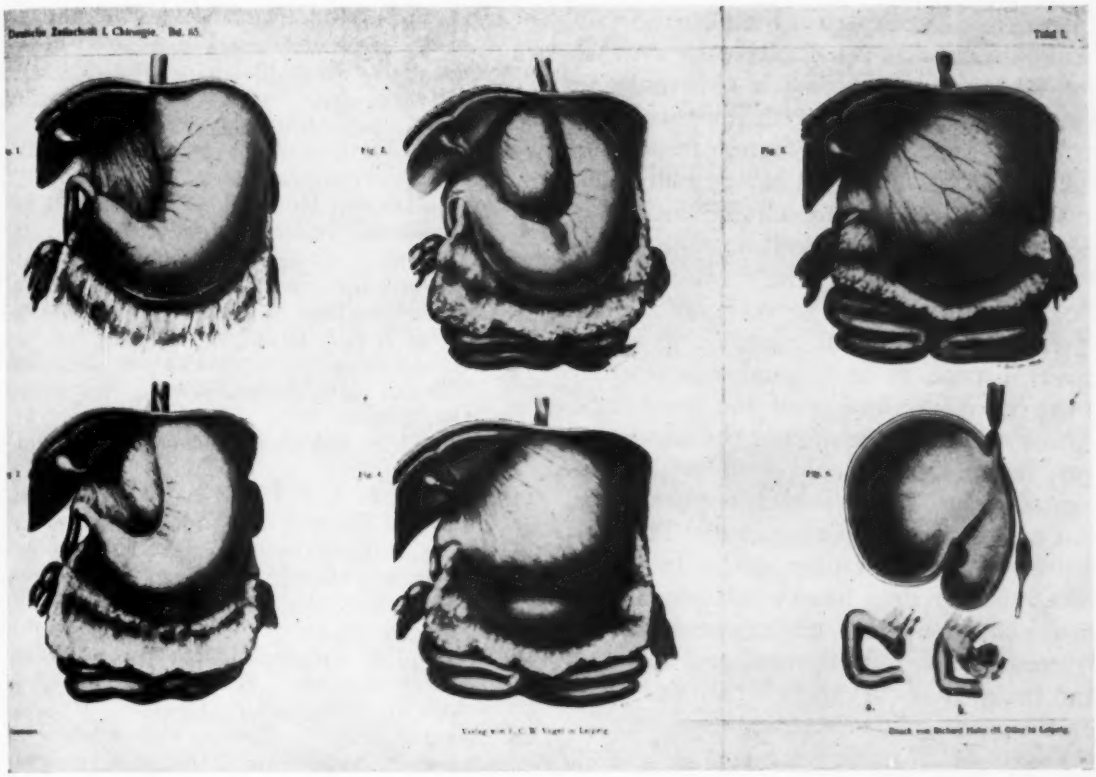


Fig. 3. Organo-axial volvulus. Drawings reproduced from Neumann[22] illustrate the gradual rotation of the stomach around its organic axis. As the greater curvature rotates posteriorly the lesser curvature together with the lesser omentum follows anteriorly, until the lesser omentum covers the anterior surface of the rotated stomach. A cross section of the lateral view shows the complete rotation with the fundus and pylorus remaining fixed in position.

tion by the omental fixation to the transverse colon. He mentions the anatomical anomaly of the failure of the fixation of the greater omentum to the transverse colon (a rare condition which he operatively found on 2 occasions) as an etiological factor. He belives that the nonfusion of the gastrocolic ligament to the greater curvature is caused by the congenital elongation of this ligament. At any rate, in all reported cases, some anomalies were present, especially the failure of the fusion of the greater omentum with the transverse colon. Kocher's[17] surgical case seems to support this theory, which attributes this condition to be congenital anomaly. Under these predisposing conditions such as gastroptosis, gastritis, hour-glass stomach, overfilling of the stomach, vomiting and gaseous distention, together with weakness of the abdominal wall—these are seen as the exciting causes of volvulus of the stomach.

There are, of course, individual cases with causes other than those mentioned. Borchardt[5] reported one with chronic stretching of the gastrocolic ligament. Hermes and Nicci reported cases with holes either congenital or acquired, in the left diaphragm, adhesions, gastric and extra-intestinal tumors. Diaphragmatic hernia is undoubtedly a predisposing factor in the lengthening of the mesenteries, which explains the relative frequent occurrence of volvulus in diaphragmatic hernia and eventration. Von Bonsdorff[4] reports a case of a gravid uterus producing gastric volvulus, which was proved at operation.

To summarize, volvulus may result secondarily to an intrinsic lesion of the stomach or to an extrinsic lesion in the neighbor-

ing organs. Most cases of total organo-axial volvulus are not associated with intrinsic pathology of the stomach. At times no cause can be demonstrated (idiopathic volvulus). Of the extrinsic factors responsible for total volvulus, an abnormally long gastrohepatic or gastrocolic omentum, or both, probably of congenital origin, seems the most important. The relationship of diaphragmatic hernia to volvulus is often mentioned. Its causal relationship is not clear, except in individual cases where there is a lengthening of the mesentery. "Aerocoly," or distention of the colon with gas, has also been suggested as an etiological factor. This in itself is not the prime, but merely a predisposing factor. The condition of hepatodiaphragmatic interposition, however, does have a relationship. In this condition, the transverse colon or splenic flexure rolls upward and forward, and the greater curvature is then pulled up by the gastrocolic omentum.

Samuel L. Beranbaum, M.D.
University Hospital
303 East 20th St.
New York 3, New York

REFERENCES

1. AZMY, S., and MAREY, A. Volvulus of stomach. AM. J. ROENTGENOL. & RAD. THERAPY, 1932, *27*, 420–421.
2. BECKER. Ueber die Magenverschlingung. *Arch. f. klin. Chir.*, 1927, *145*, 203–232.
3. BERTI. Singolare attortigliamento dell'esofago col duodeno seguito da rapida morte. *Gazz. med. Ital.*, 1866, *9*, 139.
4. v. BONSDORFF, H. J. Volvulus ventriculi. *Finska läk.-sällsk. handl.*, 1909, *51*, 287, 295.
5. BORCHARDT, M. Pathologie und Therapie des Magen-volvulus. *Arch. f. klin. Chir.*, 1904, *74*, 243.
6. BOWEN, A. Volvulus of inverted intrathoracic stomach complicating diaphragmatic hernia; case report. *Am. J. Digest. Dis. & Nutrition*, 1937, *3*, 923–928.
7. BUCHANAN, J. Volvulus of stomach. *Brit. J. Surg.*, 1930, *18*, 99–112.
8. CAILLODS, G., and COTTET, P. Volvulus sub. total et volvulus total de l'estomac. *J. de radiol. et d'électrol.*, 1929, *13*, 497–502.
9. CHOISY, R., and BABAIANTZ, L. Contribution à l'étude du volvulus de l'estomac. *Acta radiol.*, 1927, *8*, 410–418.
10. DEAVER, J. B., and ASHHURST, A. P. C. Surgery of the Upper Abdomen. P. Blakiston's Son & Co., Philadelphia, 1921.
11. FROSTBERG, N. Über Magenvolvulus. *Acta radiol.*, 1943, *24*, 217–225.
12. GILL, F. Volvulus of stomach. *Irish J. M. Sc.*, September, 1925, 418–420.
13. VON HABERER, H. Volvulus des Magens bei carcinoma. *Deutsche Ztschr. f. Chir.*, 1912, *115*, 497.
14. HAMILTON, J. B. Gastric volvulus and other abnormal rotations of stomach. AM. J. ROENTGENOL. & RAD. THERAPY, 1945, *54*, 30–40.
15. KAUTZ, F. G. Ueber einen Fall von partiellem Volvulus des Magens. *Hamb. Aerzteverein*, Oct. 2, 1928.
16. KERR, H. H. Volvulus of stomach. *Ann. Surg.*, 1912, *56*, 697–709.
17. KOCHER, T. Ein Fall von Magenvolvulus. *Deutsche Ztschr. f. Chir.*, 1914, *127*, 591–635.
18. LÄWEN, A. Über einen Magenvolvulus mit perforierten Dehnungsgeschwüren der hinteren Magenwand. *Deutsche Ztschr. f. Chir.*, 1927, *206*, 319–331.
19. MARKS, J. H. Esophageal hiatus hernia with inversion of stomach. AM. J. ROENTGENOL. & RAD. THERAPY, 1948, *60*, 63–68.
20. MORRISON, W. A. Torsion and volvulus of stomach. *Surg., Gynec. & Obst.*, 1931, *52*, 871–874.
21. MYLES, R. B. Anatomical variations of stomach and duodenum within abdominal cavity. *Brit. J. Radiol.*, 1937, *10*, 237–260.
22. NEUMANN, A. Ueber den Volvulus des Magens. *Deutsche Ztschr. f. Chir.*, 1906, *85*, 136–150.
23. NOCKOLDS, H. Volvulus of stomach. *Brit. J. Surg.*, 1924, *11*, 774–775.
24. PAYER, A. Volvulus ventriculi und die Achsendrehung des Magens. *Mitt. a. d. Grenzgeb. d. Med. u. Chir.*, 1907, *20*, 686–726.
25. RHINEHART. D. A., and RHINEHART, B. A. Congenital abnormalities of stomach. *Radiology*, 1926, *7*, 492–497.
26. RHINEHART, D. A. Concerning stomachs that are upside down. *South. M. J.*, 1936, *29*, 139–142.
27. ROSENFELD, D. H. Unusual type of inversion of stomach associated with diaphragmatic eventration and other anomalies. AM. J. ROENTGENOL. & RAD. THERAPY, 1944, *52*, 607–610.
28. ROSSELET, A., and GILBERT, R. Observation radiologique d'un volvulus de l'estomac. *J. de radiol. et d'électrol.*, 1922, *6*, 76–80.
29. SHANKS, S., and KERLEY, P., Editors. A Text-Book of X-Ray Diagnosis by British Authors in Four Volumes. Second edition. W. B. Saunders Company, Philadelphia, 1950, Vol. 3.
30. SIEGEL, E. Volvulus of stomach. *Zentralbl. f. Chir.*, 1921, *48*, 618.

31. Silverstein, I. S. Volvulus of stomach complicated by peptic ulcer. Am. J. Roentgenol. & Rad. Therapy, 1947, *57*, 578–582.
32. Singleton, A. C. Chronic gastric volvulus. *Radiology*, 1940, *34*, 53–61.
33. Thorek, M. Acute total volvulus of stomach. *J.A.M.A.*, 1923, *81*, 636–640.
34. Toygar, O. Die Formveränderungen des Magens (Kaskadenmagen, Volvulus des Magens). *Schweiz med. Wchnschr.*, 1948, *78*, 767–772.
35. Weeder, S. D. Torsion and volvulus of stomach with diaphragmatic hernia. *Ann. Surg.*, 1935, *102*, 382–386.
36. Zimmerman, C. A. W. Volvulus of stomach; report of case. *J. Missouri M. A.*, 1942, *39*, 139–141.
37. Zimmerman, C. A. W. Volvulus of stomach. *South. M. J.*, 1946, *39*, 782–786.
38. Zimmerman, C. A. W. Acute volvulus of stomach with spontaneous reduction. *J. Missouri M. A.*, 1948, *45*, 585.

GASTRIC VOLVULUS

PART II. IDIOPATHIC GASTRIC VOLVULUS

By DAVID LEFFERTS, M.D., SAMUEL L. BERANBAUM, M.D. *and* CHARLES GOTTLIEB, M.D.

University Hospital

NEW YORK, NEW YORK

IN THE preceding presentation (Part I) the historical development, the anatomical considerations, and the etiology of gastric volvulus have been outlined. With this background, a series of cases is presented with an effort to place them in their proper categories.

Gastric volvulus may be present without symptoms, or may produce intermittent mild or acute upper abdominal distress, depending on the degree of rotation. Toygar[34] stresses Borchardt and Lenormant's triad, consisting of strong efforts to vomit without result, circumscribed epigastric pain, and impossibility of passing a stomach tube. He prefers to have the patient swallow barium instead of passing a sound, in view of the danger of perforation.

Volvulus up to 180 degrees may be present without obstruction or strangulation of blood supply and may undergo spontaneous resolution. Beyond rotation of 180 degrees the patients present an acute abdomen with signs of complete obstruction, and the possibility of continuing strangulation. At this point death may occur if the volvulus is unreduced surgically.

Idiopathic Volvulus

A. Organo-axial

Case I (Fig. 1). Total organo-axial volvulus, supracolic type, anterior rotation. W.K., a sixty-two year old male, complained intermittently of epigastric pressure, especially after meals, with flatulence and belching. Roentgen examination revealed a total organo-axial volvulus, the greater curvature forming the upper outline of the stomach. There was anterior rotation with the stomach being supracolic in position. There was no demonstrable etiology. The transverse colon was in close proximity to the stomach.

Two years later the patient was operated upon elsewhere, in view of a clinical impression of intestinal obstruction. No organic lesion was found at operation. No attention was paid to the position of the stomach. It was mentioned, however, that there was a very large gastrocolic omentum.

Case II (Fig. 2). Organo-axial volvulus, supracolic type. H.P., a seventy-seven year old male, was admitted to the Urological Service with an enlarged prostate. In view of a history of intermittent epigastric discomfort, occasional nausea and tarry stools three years earlier, a gastrointestinal series was performed. This revealed a classical organo-axial volvulus, with the colon inferior to, but in close association with the stomach (supracolic type of volvulus). There were also multiple duodenal and small intestinal diverticula.

The urological condition was treated surgically; the gastrointestinal, medically.

Case III (Fig. 3). (Courtesy of Dr. M. J. Feder.) Organo-axial volvulus, supracolic type. A.B., a sixty-two year old white male, complained of substernal pressure and dyspnea after meals. He had also developed burning epigastric pain in the past three months, with intermittent dysphagia with respect to solid foods.

Roentgen examination showed an organo-axial volvulus, the greater curvature being uppermost against the diaphragm. Due to the rotation, in the oblique position the stomach appears shortened. No organic cause for the rotation was demonstrated.

Case IV (Fig. 4). Organo-axial volvulus, supracolic type. J.W.H., a forty-seven year old white male, was admitted with alkalosis. There was a history of increasing chronic constipation. with the ingestion of increasing amount of milk of magnesia and Fleet's phosphosoda. Three days prior to admission he developed increased constipation with cramps. He ingested a total of 500 milk of magnesia tablets, at least a pint

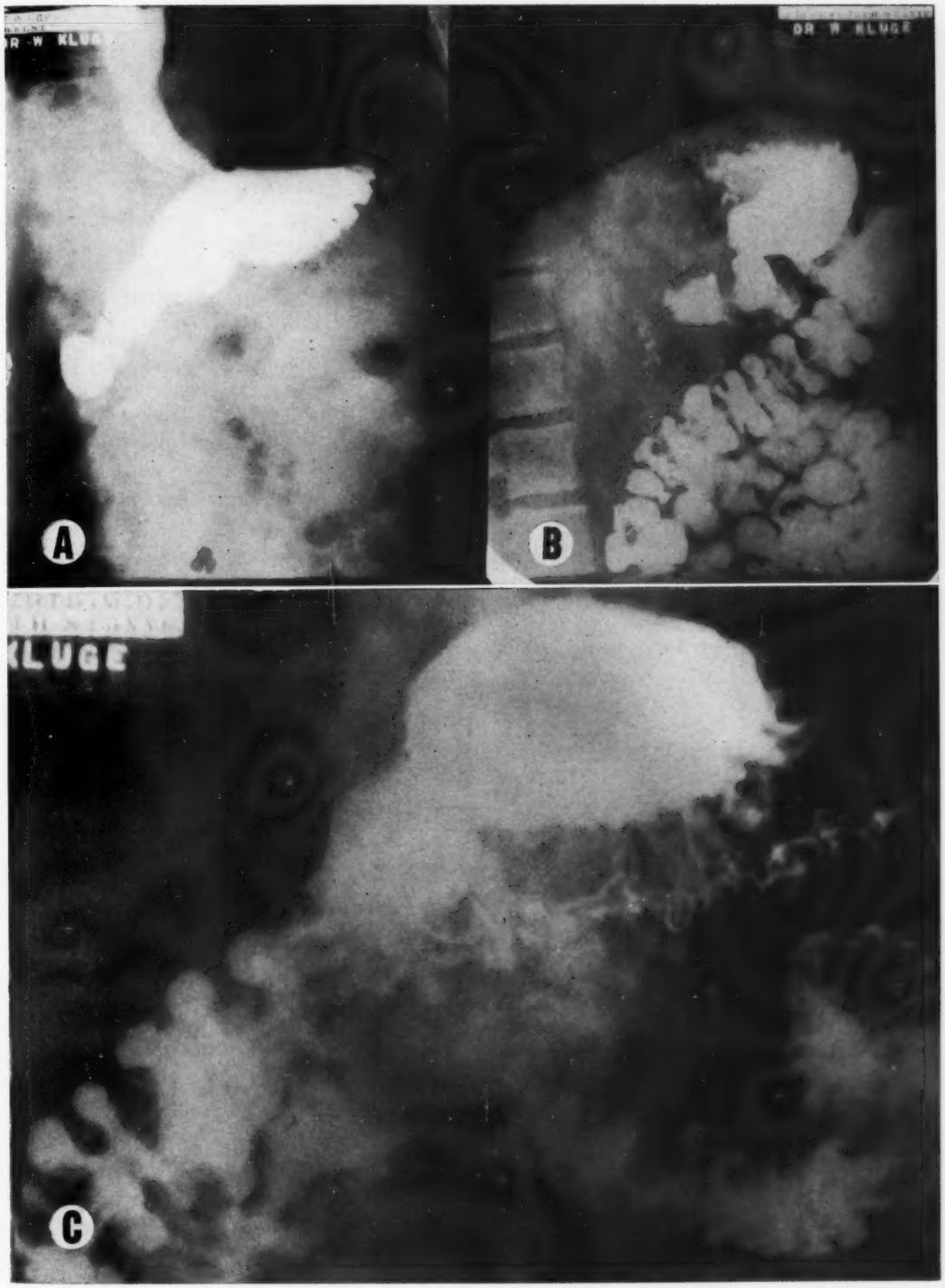


Fig. 1. Total organo-axial volvulus, supracolic type anterior rotation. (*A*) Upright posture showing the esophagus entering the pars cardia at a relatively low level. (*B*) (*C*) Right lateral recumbent and prone postures illustrating the close proximity of the transverse colon to the stomach. In the prone position the greater curvature is adjacent to the diaphragm. The rugae of the pars cardia together with the lesser curvature form the lower outline of the stomach.

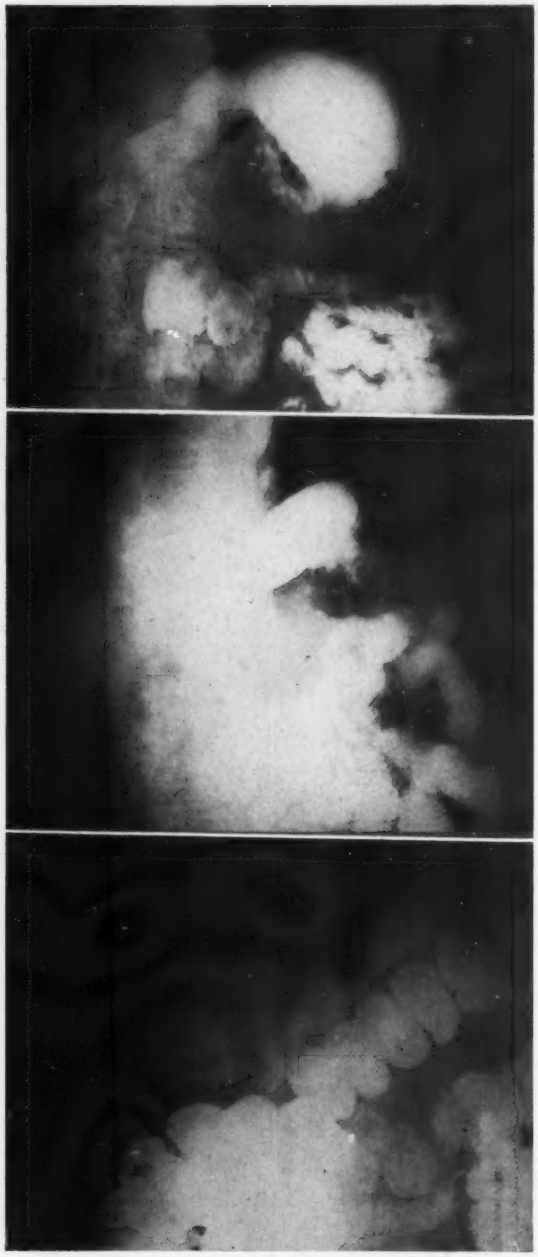


Fig. 2. Total organo-axial volvulus supracolic type. All views in the prone position, with the greater curvature forming the superior outline. Again the close relationship of the colon to the stomach is demonstrated. The duodenal diverticula are incidental.

of phosphosoda, and a large quantity of phenolphthalein.

After his alkalosis was corrected, he was examined roentgenologically. The stomach was rotated on itself along its organic axis (organo-axial volvulus). The transverse colon was very high in the abdomen and located immediately below the stomach. No intrinsic organic lesion was observed (idiopathic supracolic organo-axial volvulus).

Case v (Fig. 5). Organo-axial volvulus, supracolic type. J.P., a forty-eight year old white male, complained of choking sensations after eating, eructations and epigastric distress, with occasional vomiting. Physical examination was negative. Roentgen examination showed an organo-axial volvulus.

Case vi (Fig. 6). Organo-axial volvulus, supracolic type. R.D., a sixty-three year old male, complained of intermittent epigastric pain of ten years' duration, occurring only after overindulgence, lasting three to four hours, at times requiring hypodermics for relief. Significantly the pain subsides only after belching and passage of gas per rectum.

Roentgen examination showed an organo-axial volvulus, with two fluid levels in the upright position. The colon was closely associated with stomach, which was rotated so that the greater curvature was uppermost.

B. *Mesentero-axial*

Case vii (Fig. 7). Mesentero-axial volvulus, infracolic type. C.W., a fifty-year old white female, complained of epigastric discomfort and gaseous distention of two years' duration. There was occasional nausea, with induced vomiting.

Roentgen examination revealed a hepato-diaphragmatic interposition, with a mesentero-axial volvulus of the stomach. The stomach has rotated to the right along the mesenteric axis. The greater curvature is above the level of the lesser curvature and is located to the right of the lesser curvature.

This infracolic type of volvulus is rare in our experience.

Case viii (Fig. 8). Idiopathic mesentero-axial volvulus with spontaneous reduction (Type B as illustrated in the tracing by Kocher), infracolic type. J.A., a sixty-five year old male, complained intermittently for years of epigastric distress and belching, with the pain radiating to the left side of the chest. In view of the latter symptoms associated with hypertension and dyspnea, a diagnosis of coronary heart disease was entertained. However, in view of the epigastric distress and marked degree of belching,

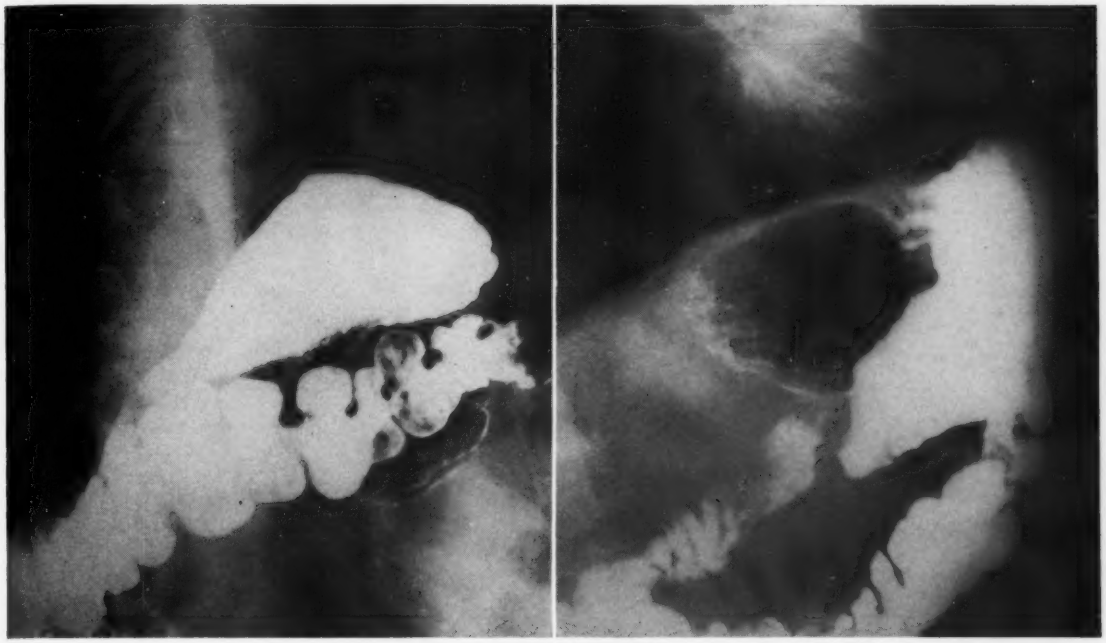


Fig. 3. (Courtesy of Dr. M. J. Feder.) Total organo-axial volvulus, supracolic type. The greater curvature forms the upper outline. The transverse colon is closely associated with the stomach, the pars cardia being below the level of the colon. The oblique view shows the greater curvature uppermost immediately under the diaphragm as if the rotated stomach were riding on the splenic flexure.

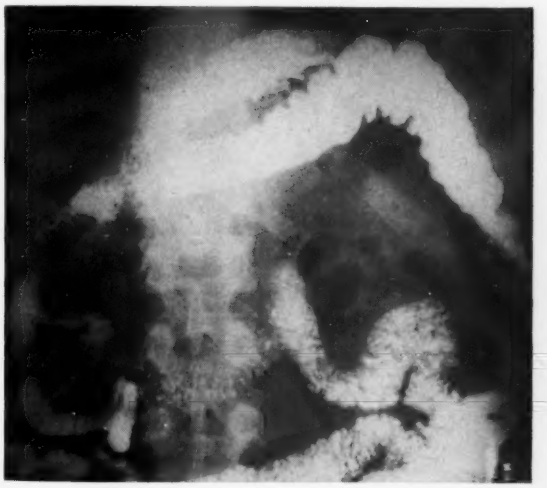


Fig. 4. Total organo-axial volvulus, supracolic type. The greater curvature is uppermost. The transverse colon and splenic flexure are closely related to the lesser curvature. The upward rotation produces an apparent widening of the duodenal loop, with the typical downward direction of the duodenal bulb.

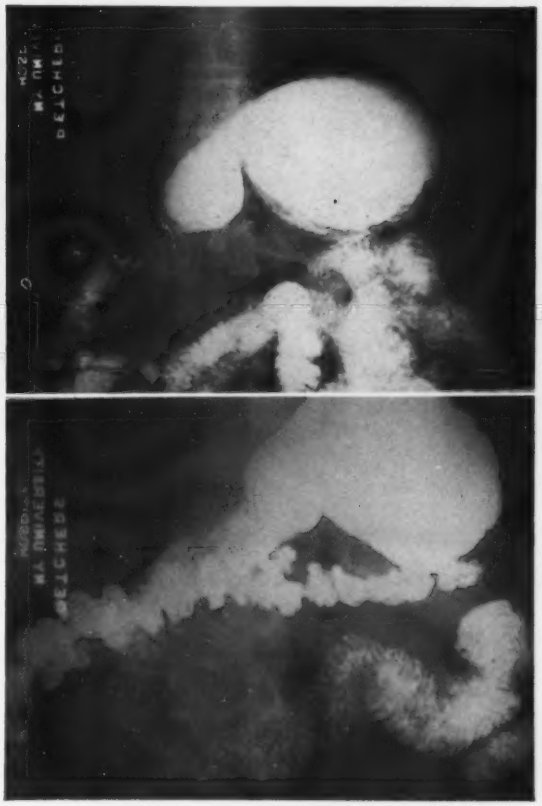


Fig. 5. Total organo-axial volvulus, supracolic type, with the same features illustrated in Figure 4. The downward direction of the bulb and the apparent increased sweep of the duodenal loop are again illustrated.

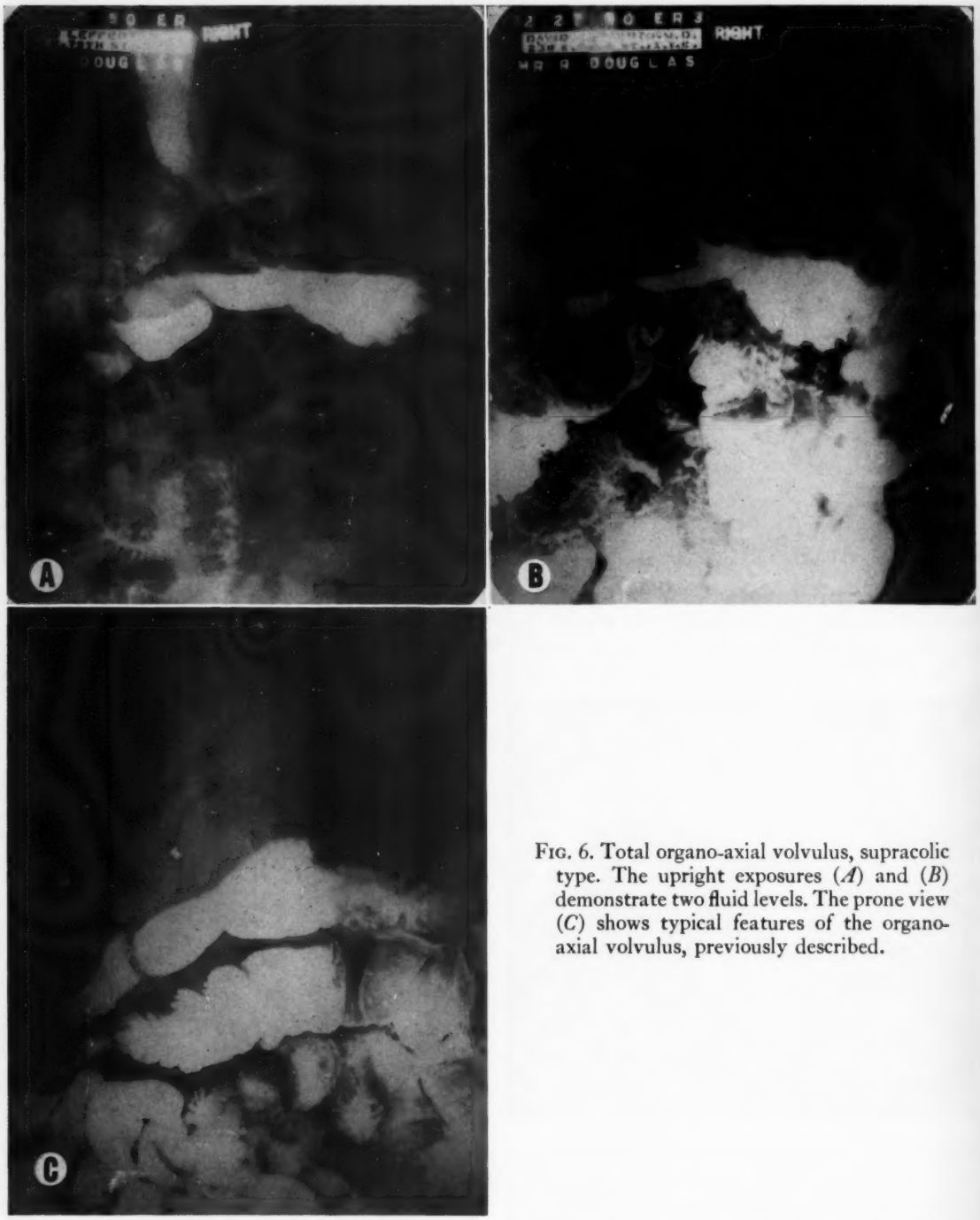


Fig. 6. Total organo-axial volvulus, supracolic type. The upright exposures (*A*) and (*B*) demonstrate two fluid levels. The prone view (*C*) shows typical features of the organo-axial volvulus, previously described.

a gastrointestinal series was undertaken.

This showed a total volvulus around the mesenteric axis, the volvulus being infracolic in type, with anterior rotation. The great degree of aerocoly was probably of etiological significance. No organic lesion was demonstrated.

A re-examination one year later showed a spontaneous reduction, revealing a large ptopic stomach (Fig. 9).

Case ix (Fig. 10). Mesentero-axial volvulus, infracolic type. M.B., a forty-two year old white female, complained of gaseous eructations with abdominal distention intermittently for several

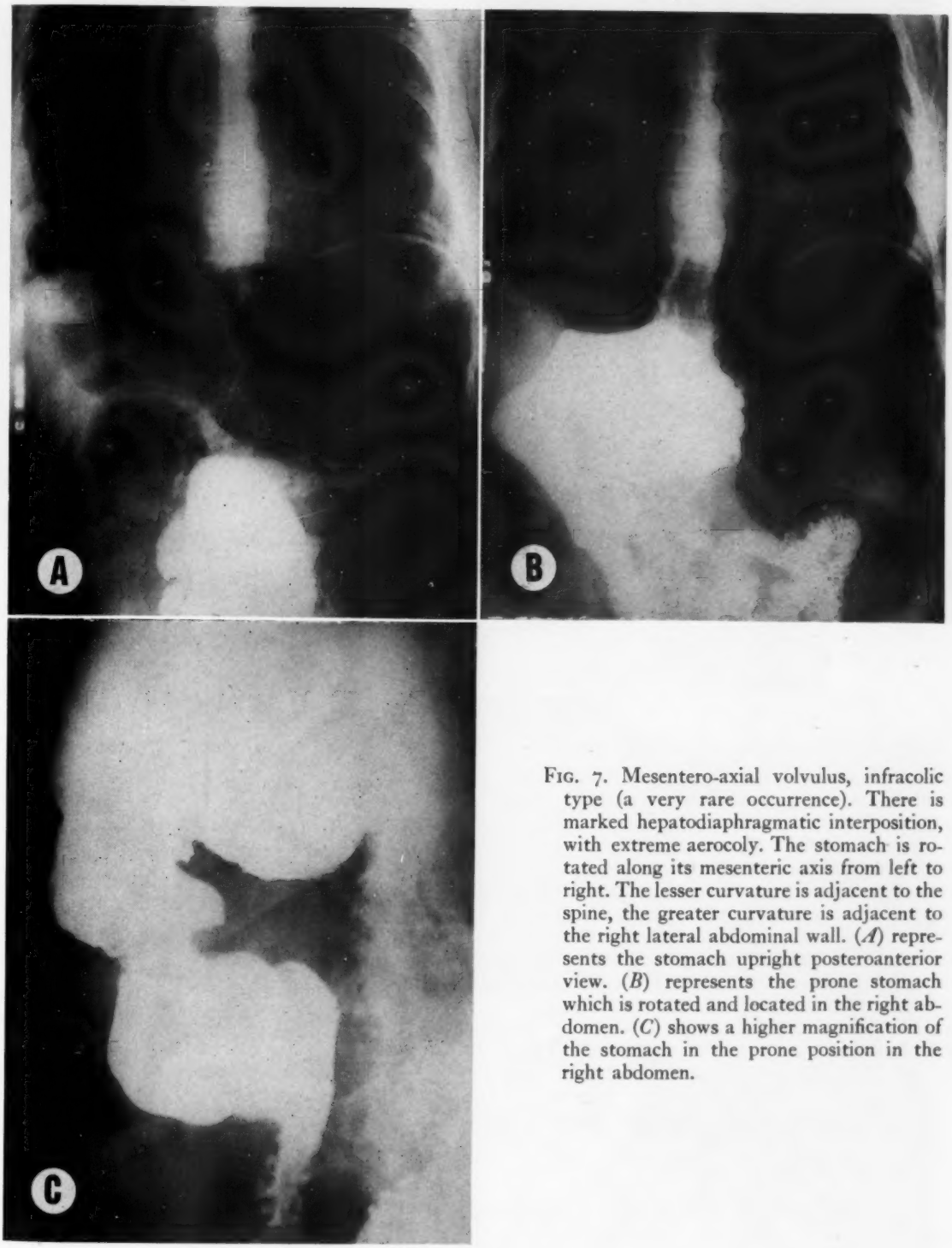


Fig. 7. Mesentero-axial volvulus, infracolic type (a very rare occurrence). There is marked hepatodiaphragmatic interposition, with extreme aerocoly. The stomach is rotated along its mesenteric axis from left to right. The lesser curvature is adjacent to the spine, the greater curvature is adjacent to the right lateral abdominal wall. (*A*) represents the stomach upright posteroanterior view. (*B*) represents the prone stomach which is rotated and located in the right abdomen. (*C*) shows a higher magnification of the stomach in the prone position in the right abdomen.

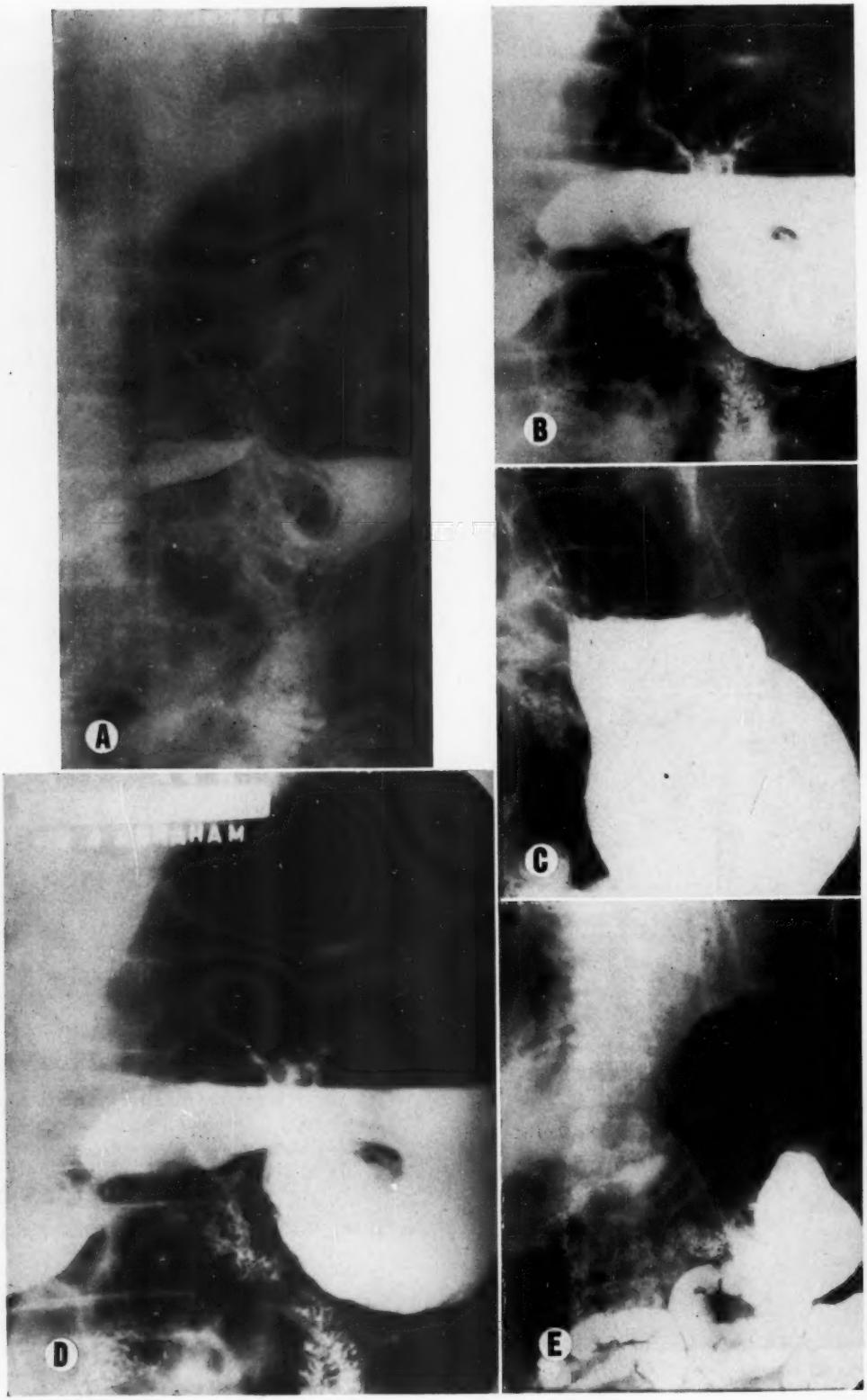
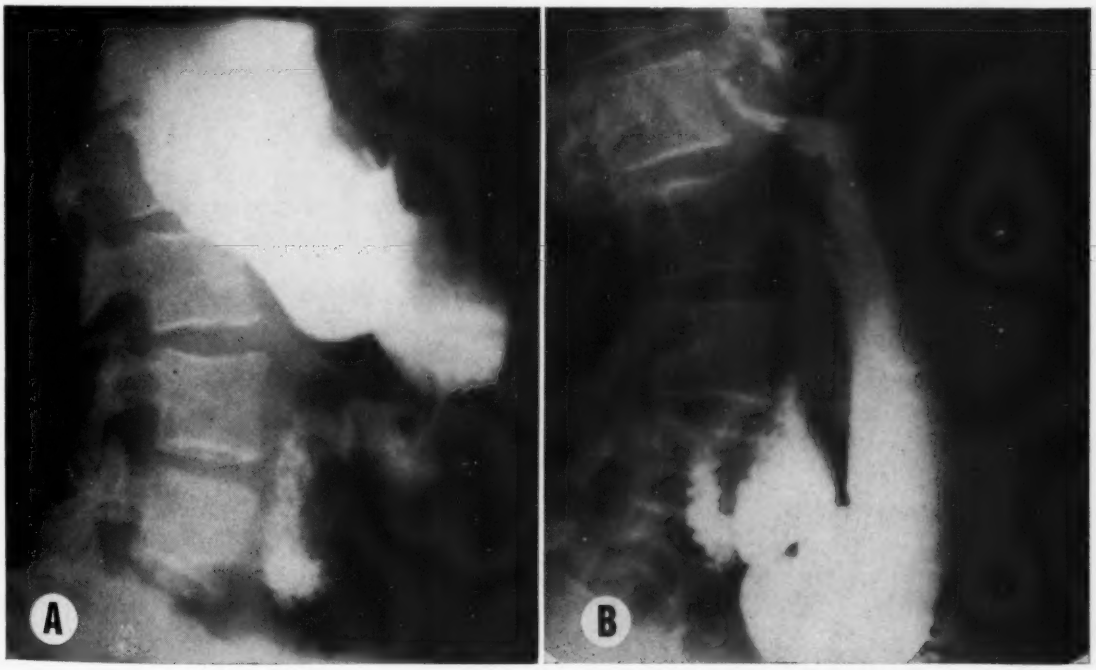

A
B
C
D
E

FIG. 8. Total mesentero-axial volvulus, infracolic type. The upright views (*A*) (*B*) and (*D*) taken slightly oblique show the typical twist of the stomach with a characteristic radiolucent area. (*A*) represents a mucosal study, whereas the others represent the stomach after a full meal. The characteristic twist is obscured in the direct posteroanterior views, both erect (*C*) and in the prone (*E*). In the posteroanterior upright (*C*) the stomach has a saccular appearance which is also typical for this type of volvulus. The transverse colon is shown by its gaseous distention above the level of the stomach (*E*).

FIG. 9. An upright view of the same patient illustrated in Figure 8, about one year later, with a large ptotic stomach, pars cardia distended with gas, but otherwise completely normal.

FIG. 10. Both exposures in the upright (*A*) taken about five minutes before (*B*). In (*A*) the mesentero-axial volvulus is demonstrated with two fluid levels. Additional exposures demonstrating this condition more thoroughly were rendered impossible because of spontaneous reduction shown in (*B*).



years. The preliminary abdominal film showed the colon distended with gas, the splenic flexure high under the diaphgram. Initially during roentgenoscopy the stomach assumed a sac-like appearance, similar to that shown in Figure 8*C*. The oblique view illustrated in Figure 10*A* taken in the upright position shows a volvulus, the rotation occurring along the mesenteric axis, with two fluid levels. Immediately after the exposure was made, the patient complained of increasing pressure in the epigastrium. Very dramatically during roentgenoscopy the stomach reversed itself and assumed a normal position as demonstrated in Figure 10*B*, taken about five minutes later.

CONCLUSION

Nine cases of idiopathic gastric volvulus are presented, six organo-axial, three mesentero-axial. In this series, the former were supracolic in type, the latter infracolic.

Gastric volvulus secondary to a demonstrable lesion of etiological significance will be discussed later.

Samuel L. Beranbaum, M.D.
University Hospital
303 East 20th St.
New York 3, New York

Vol. 72, No. 4

GASTRIC VOLVULUS

PART III. SECONDARY GASTRIC VOLVULUS

By SAMUEL L. BERANBAUM, M.D., CHARLES GOTTLIEB, M.D., *and* DAVID LEFFERTS, M.D.

University Hospital

NEW YORK, NEW YORK

GASTRIC volvulus may be primary (idiopathic) or secondary. The latter may be due to multiple causes of etiological significance as outlined in the classification in Part I. In designating the volvulus as secondary, there must be an organic lesion which is significant as a causative factor. The demonstration only of an incidental pathological entity, in itself is insufficient for inclusion in this series. If it does not have direct bearing on the volvulus it is more accurately classified as idiopathic (see Part II).

A. *Organo-axial Volvulus, Secondary to Eventration of the Diaphragm.*

Case I (Fig. 1*A* and *B*). E.R., a sixty-four year old male, with repeated intermittent attacks of epigastric pain with syncope of thirty years' duration. Three years ago, after a heavy meal, he had a sudden seizure of epigastric pain with syncope which was assumed to be a coronary. Electrocardiographic and sedimentation studies were repeatedly negative and the patient made a full recovery after one week of hospitalization.

Seven months before the present examination, the attacks became more frequent accompanied by tarry stools and anemia (hemoglobin 62 per cent).

Roentgen examination showed an eventration of the left diaphragm with a high splenic flexure. There is an organo-axial volvulus involving the distal half of the stomach. No organic lesion was demonstrated in the stomach or duodenum.

The patient made a slow but progressive recovery on medical therapy.

Case II (Fig. 2). B.R., a seventy-two year old female, complained of heartburn, flatulence and epigastric pain for many years. A few weeks prior to this examination she developed anorexia, weight loss, nausea, but no vomiting.

Roentgen examination showed an eventration of the left diaphragm. The stomach was displaced upward and rotated anteriorly along the organic axis. There was an incidental finding of a diverticulum of the cardia. There was rigidity in the antrum, with absent peristalsis.

At operation, there was a large inoperable carcinoma of the pancreas, which had invaded the antrum, and had rotated the stomach as described.

This case presents two associated etiological factors, namely, eventration of the diaphragm, and neoplasm of the pancreas.

Case III (Fig. 3). I.S., a fifty-four year old white female, complained of dyspepsia and left upper quadrant pain radiating to the left shoulder, of several years' duration. There was associated nausea, with induced vomiting, as well as fatty and fried food intolerance. The patient had a cholecystectomy in May, 1947. The pathological diagnosis was hydrops of the gallbladder, cholecystitis and cholelithiasis. The stomach was not examined. She had an uneventful recovery, with relief of symptoms until August, 1947, when there was a recurrence of the epigastric pain, which persisted.

A gastrointestinal series was finally performed in October, 1948. This revealed an eventration of the left diaphragm with resultant secondary volvulus of the stomach. The pars cardia was the lowermost part of the stomach, with pars media adjacent to the diaphragm. The esophagus entered the stomach below the diaphragm normally at the pars cardia.

The patient's symptoms were not severe enough to warrant operative intervention and she has continued on medical therapy.

B. *Organo-axial Volvulus, Secondary to Hiatus Hernia.*

Case IV (Fig. 4). B.E., a sixty-five year old white female, complained of vomiting after every meal for the past six months, with resultant 12 pound weight loss. No other symptoms were present.

Roentgen examination revealed a hiatus hernia of the stomach, with secondary volvulus,

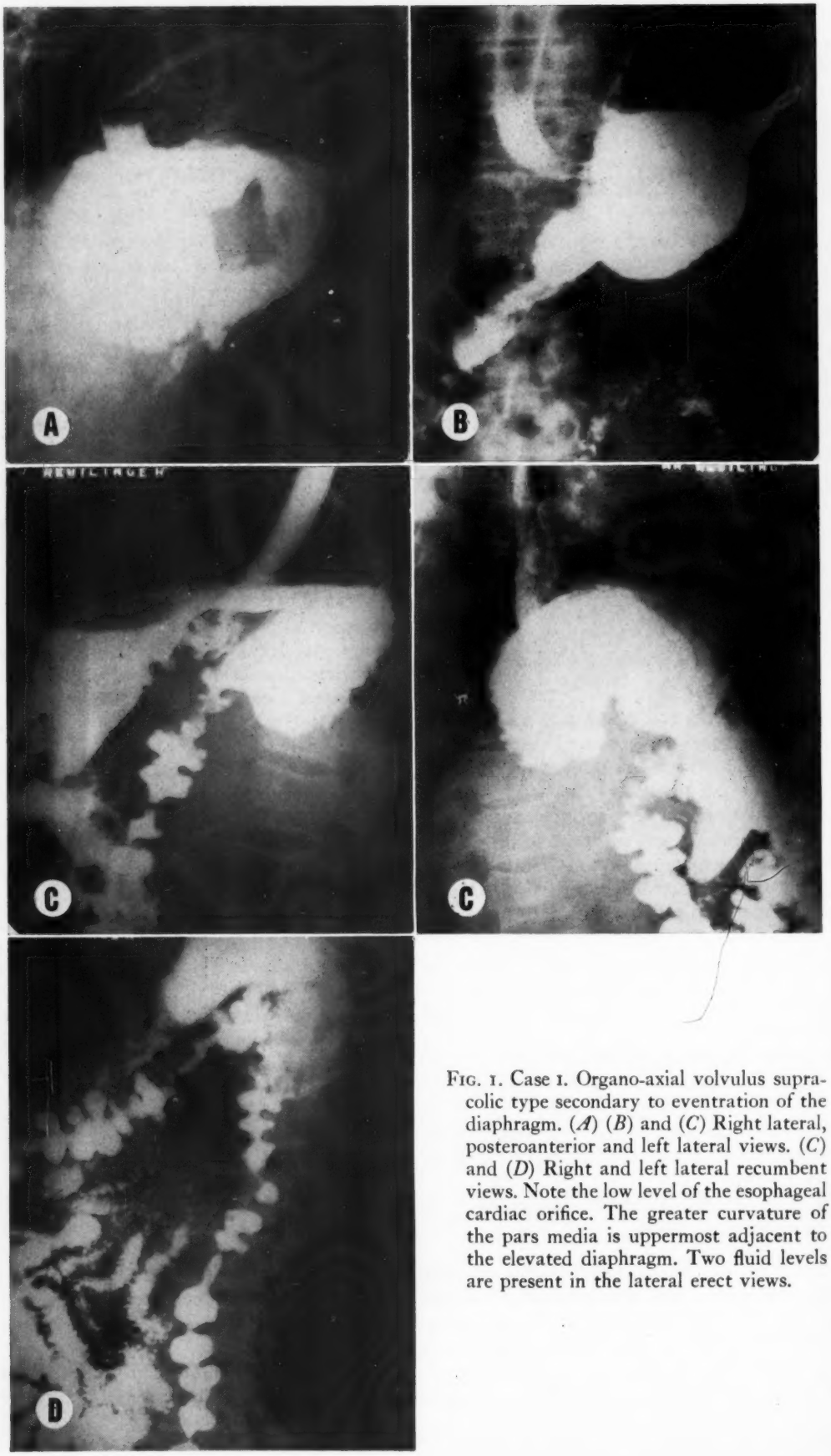


FIG. 1. Case 1. Organo-axial volvulus supracolic type secondary to eventration of the diaphragm. (*A*) (*B*) and (*C*) Right lateral, posteroanterior and left lateral views. (*C*) and (*D*) Right and left lateral recumbent views. Note the low level of the esophageal cardiac orifice. The greater curvature of the pars media is uppermost adjacent to the elevated diaphragm. Two fluid levels are present in the lateral erect views.

Fig. 2. Case II. Organo-axial volvulus supracolic type secondary to eventration of the diaphragm. At operation a neoplasm of the pancreas had invaded and rotated the antrum. There is also an incidental finding of a *diverticulum* of the pars cardia.

occurring at pars media, which was also in the herniated portion of the stomach.

The patient has been followed medically. Her symptoms were not sufficiently severe to warrant operation.

Organo-axial Volvulus, Secondary to Diaphragmatic Hernia.

Case V (Fig. 5) F.R., a forty-five year old white female, was admitted in April, 1941, with a two year history of intermittent vomiting of ingested food with dysphagia. At this time a diagnosis of cardiospasm was established roentgenographically. The patient was readmitted in June, 1941, when a Wengel procedure was performed, consisting of a muscle splitting operation with longitudinal incisions through the lower end of the esophagus and continuing into the stomach.

The patient was well without symptoms until May, 1942. She was admitted on May 18, 1950, with a history of coffee-ground vomiting of three days' duration. This was of sudden onset and continued projectile in character. The patient continued to complain of epigastric pain. She was distended and markedly dehydrated. Respirations were shallow and increased. Patient was in alkalosis with a carbon dioxide combining power of 80 per cent. A gastrointestinal examination again showed a dilated esophagus. There was gastric volvulus with pars cardia the most dependent portion of the stomach. Two-thirds of the stomach was above the level of the lower end of the esophagus with rotation along the organic axis of more than 180 degrees, resulting in total obstruction. At the time of the roentgen examination, the volvulus was considered secondary to eventration of the diaphragm.

No barium left the stomach even beyond twenty-four hours.

After restoration of the electrolyte balance, an exploratory operation was performed. The surgeon's note follows in part: "The major portion of the stomach, which resembled an inverted U in relationship to its proximal and distal normal anatomical attachments, was found in the left hemithorax. This was found above the diaphragm (herniation). The diaphragm was thickened and firmly adherent to the omentum, which was also above the diaphragm. The lower part of the lower lobe and a portion of the lingula were atelectatic."

The hernia and volvulus were reduced and the patient eventually went on to recovery.

Organo-axial Volvulus, Secondary to Hiatus Hernia.

Case VI (Fig. 6). (Courtesy of Dr. L. Auerbach.) M.H., a sixty-nine year old white male, complained of constipation, heartburn and chest discomfort of long duration. A routine chest examination led to the suspicion of a hiatus hernia which was investigated by an opaque meal. There was a large para-esophageal hiatus hernia of almost the entire stomach. In addition, the stomach was rotated 180 degrees on its organic axis with multiple fluid levels in the upright, best observed in the lateral and oblique positions.

C. *Organo-axial Volvulus, Secondary to Ulcer and/or Adhesions.*

Case VII (Fig. 7). M.J., a fifty-seven year old male, with history of epigastric pain radiating to the back, two to three hours after meals, of ten years' duration. He had several episodes of tarry stools. Repeated gastrointestinal series failed to reveal any evidence of ulcer. Consider-

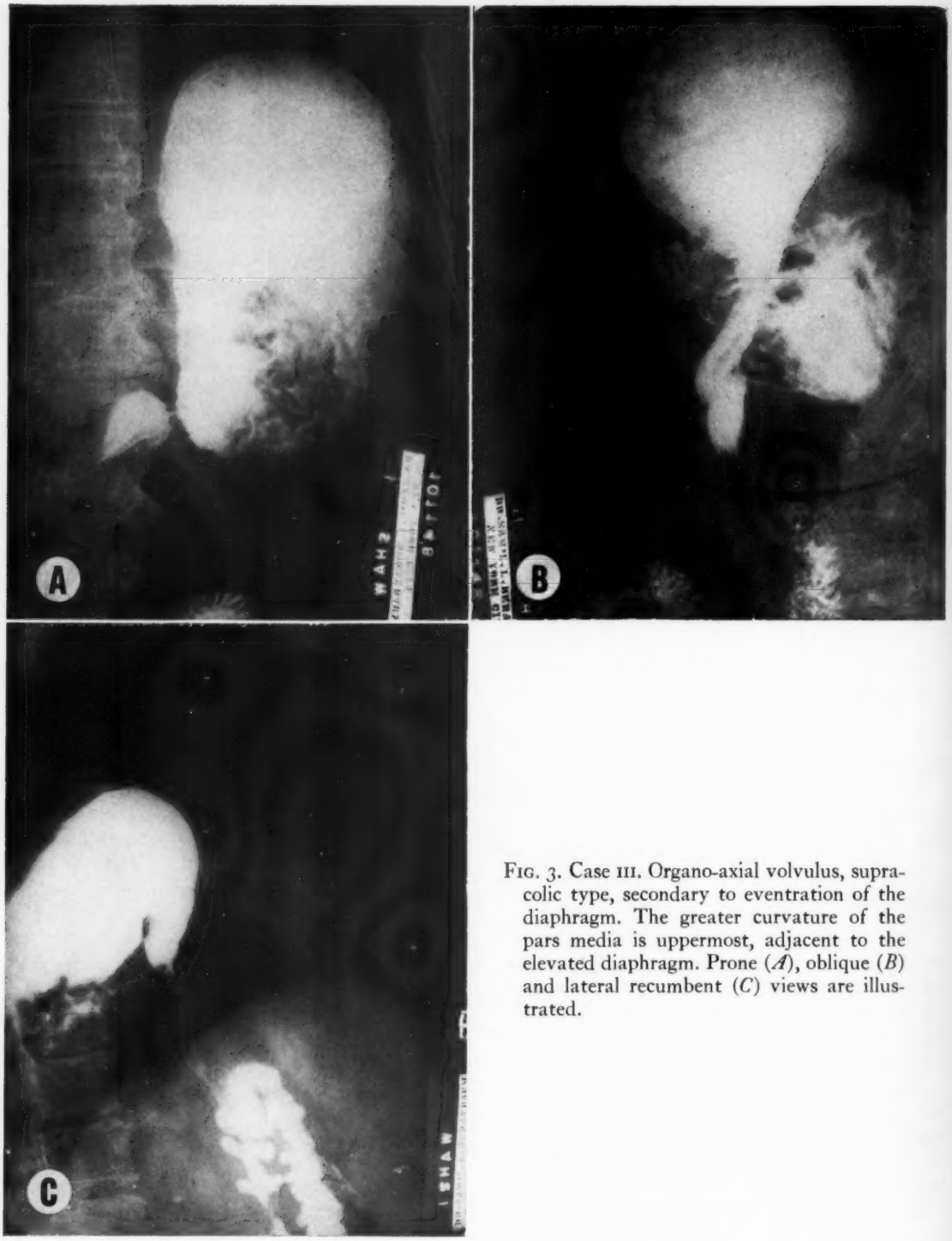


Fig. 3. Case III. Organo-axial volvulus, supracolic type, secondary to eventration of the diaphragm. The greater curvature of the pars media is uppermost, adjacent to the elevated diaphragm. Prone (*A*), oblique (*B*) and lateral recumbent (*C*) views are illustrated.

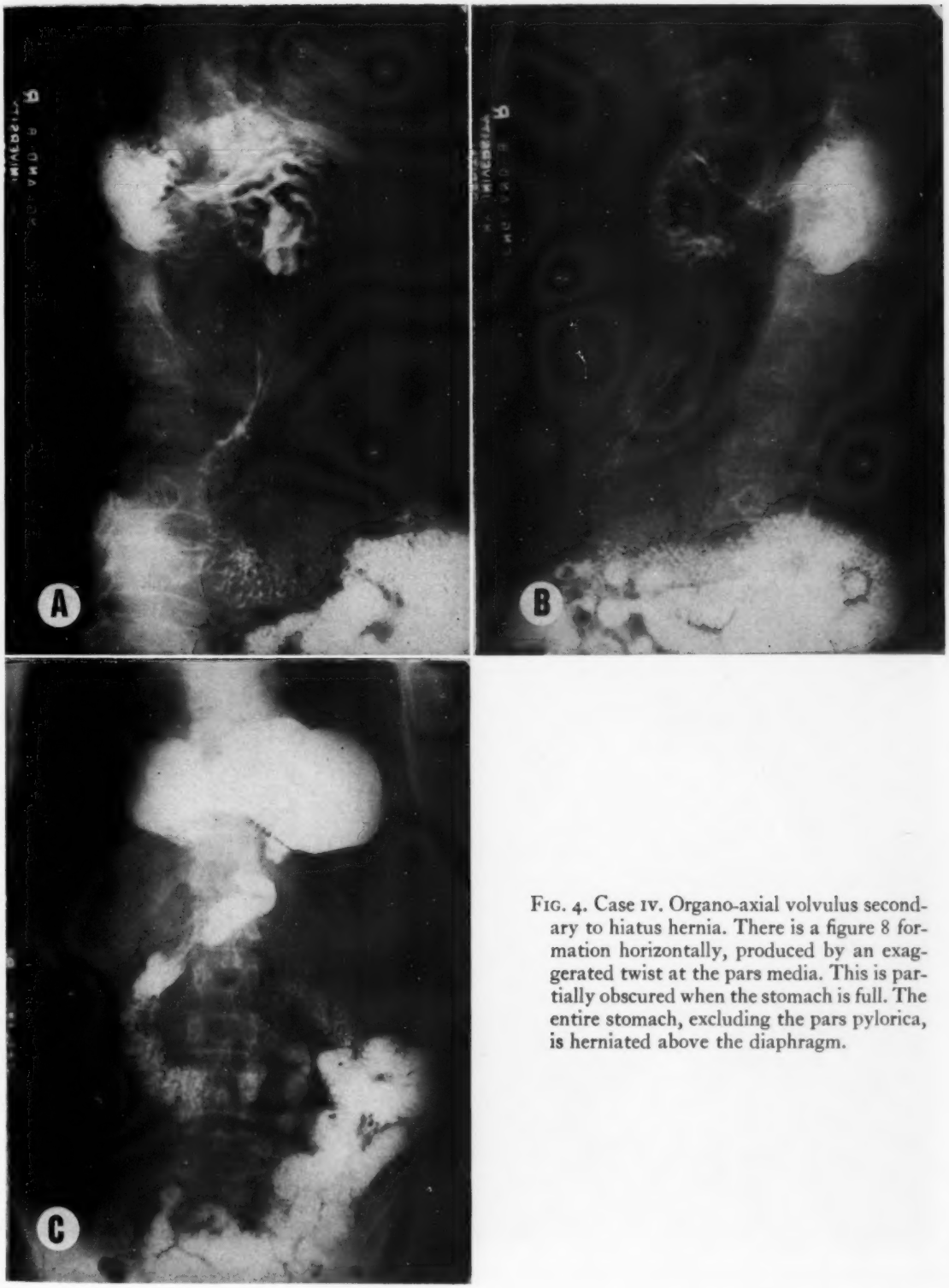


Fig. 4. Case IV. Organo-axial volvulus secondary to hiatus hernia. There is a figure 8 formation horizontally, produced by an exaggerated twist at the pars media. This is partially obscured when the stomach is full. The entire stomach, excluding the pars pylorica, is herniated above the diaphragm.

FIG. 5. Case v. Organo-axial volvulus secondary to hiatus hernia, the uppermost portion of the stomach being the greater curvature of the pars media, and simulating an elevated diaphragm on the chest film. Rotation over 180° has occurred, resulting in total obstruction, and presenting the clinical picture of an acute abdominal emergency. The only portion of the stomach remaining in the abdominal cavity was pars cardia. The findings were confirmed at operation.

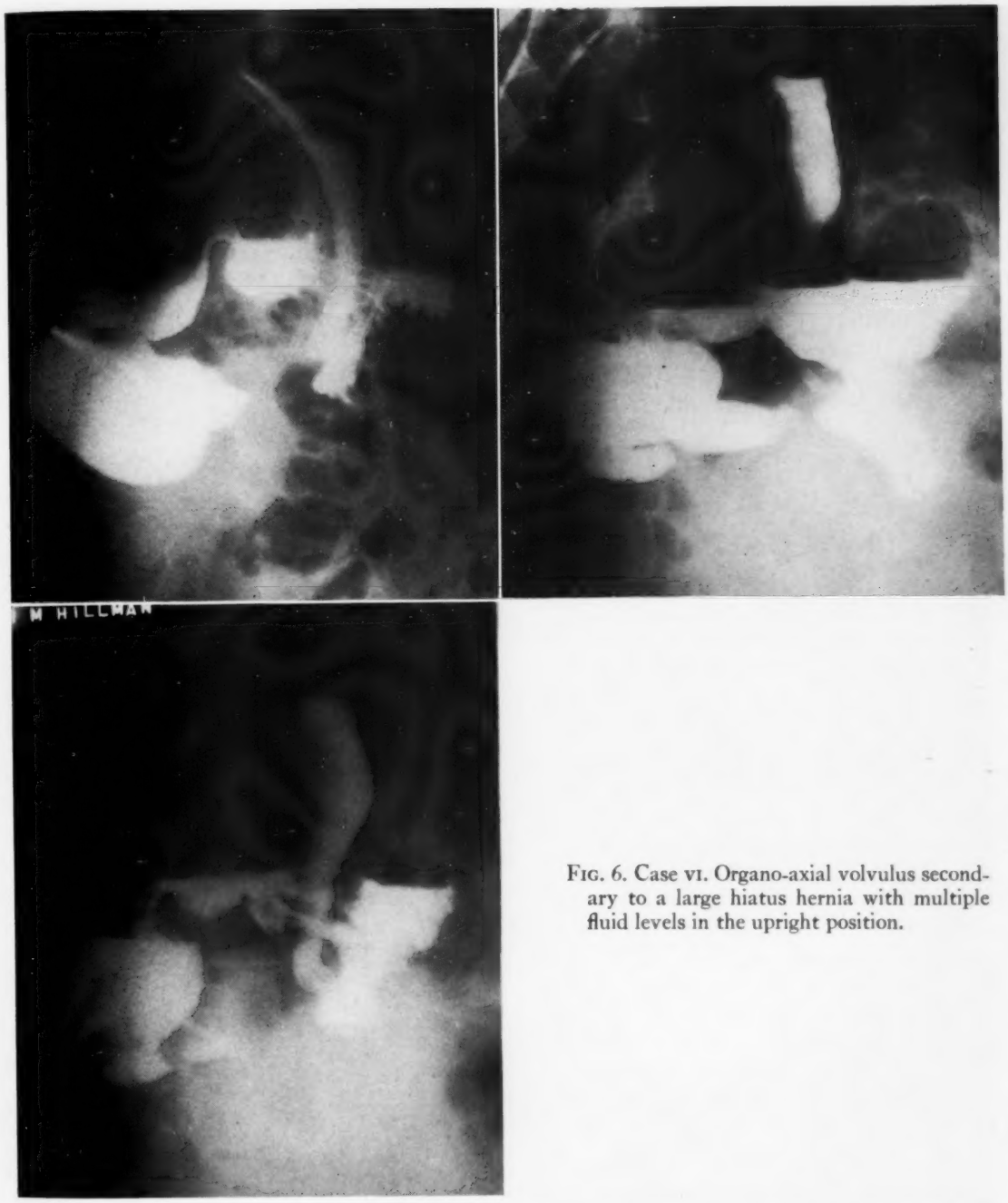


Fig. 6. Case VI. Organo-axial volvulus secondary to a large hiatus hernia with multiple fluid levels in the upright position.

able gaseous distention was reported.

He improved on an ulcer regimen. Periodic attacks of tarry stools and syncope persisted. Intermittent postprandial epigastric pain continued with nausea and occasional vomiting. The last examination was made in November, 1949, at which time a duodenal ulcer niche was demonstrated for the first time.

Of major interest was the presence of an organo-axial volvulus with evidence of two fluid levels, one in the pars cardia on the left side, and another in the pars pylorica on the right side. The twist occurred at the pars media. The submitted films show the volvulus present in 1947 at which time its true significance was not recognized. The findings on the two examinations are quite similar, differing only in detail. This case presents the significant findings of

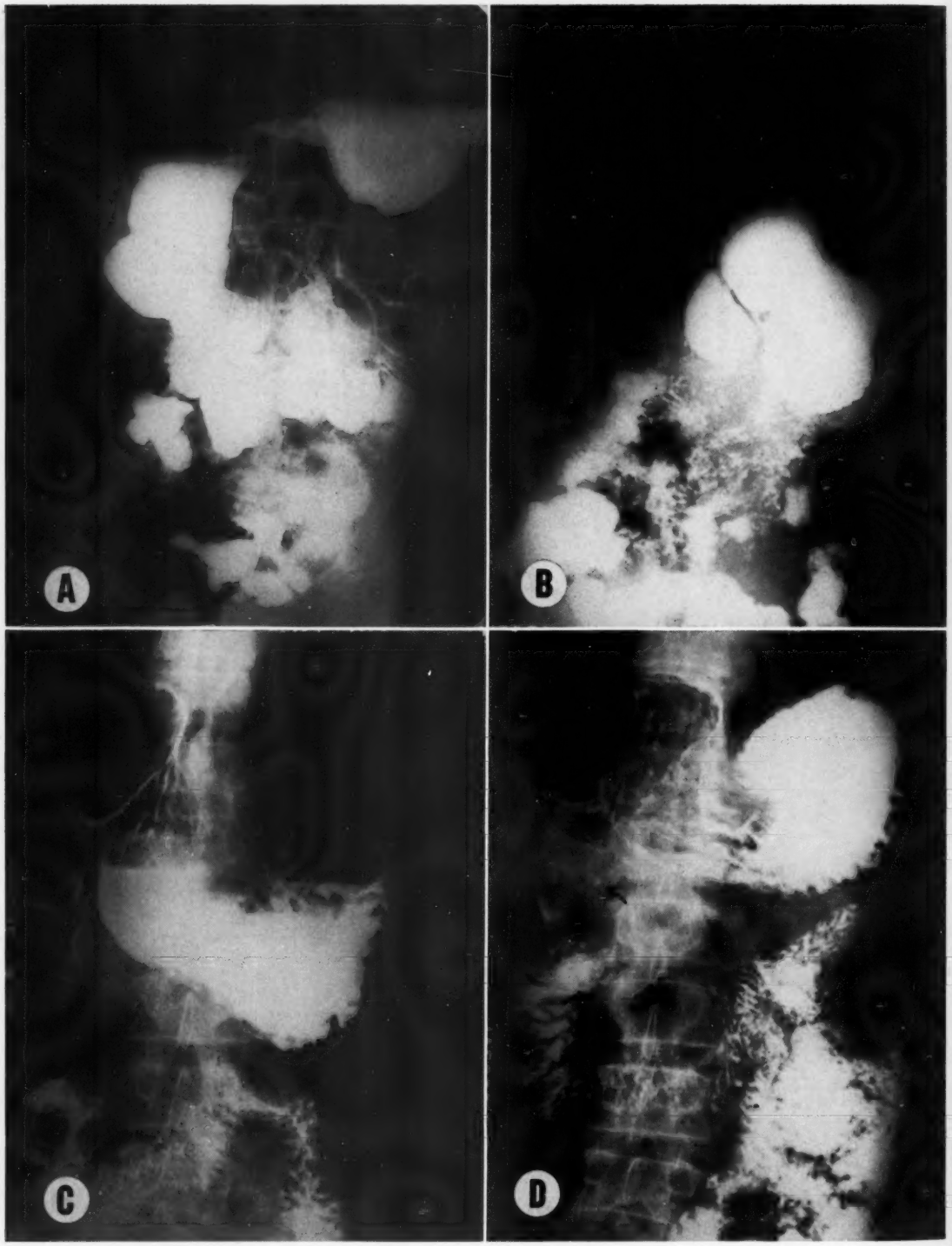


Fig. 7. Case vii. Organo-axial volvulus secondary to ulcer and adhesions. An arrow points to the crater in the bulb. (*A*) and (*B*) were taken in 1947; (*C*) and (*D*) in 1949. In both examinations, the upright views show two fluid levels. There is a large cascade of the cardiac pouch. The twist begins at the pars media, with the result that the pars pylorica is as high or higher than the pars media. The findings were confirmed at operation.

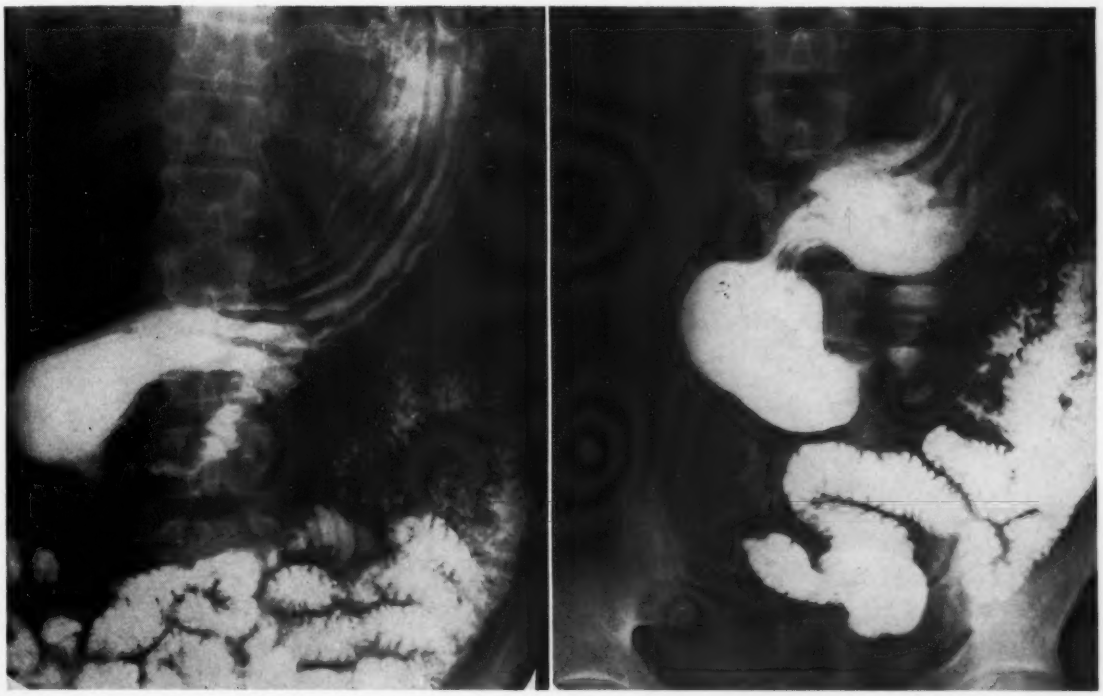


Fig. 8. Case viii. Partial organo-axial volvulus secondary to postoperative adhesions and marginal ulcer. A partial gastric resection had been performed previously for duodenal ulcer. The prone films demonstrate the volvulus beginning at the pars media of the stomach. Subtotal gastrectomy confirmed the findings.

two gastric fluid levels in the upright position, a sign specifically stressed by Singleton.

The patient came to surgery where the presence of the volvulus and the duodenal ulcer was confirmed exactly as described roentgenologically. There were numerous adhesions. A gastric resection was performed, and the patient made an uneventful recovery.

Organo-axial Volvulus, Secondary to Postoperative Adhesions and Marginal Ulcer.

Case viii (Fig. 8). J.S., a forty-seven year old white female, with a history of an operation for duodenal ulcer performed eighteen years earlier in Germany. She again sought medical aid because of epigastric pain, and weight loss of a few months' duration. A gastrointestinal series, performed on July 3, 1946, showed a partial volvulus of the distal half of the stomach around the organic axis. The stomach is rather long in spite of a resection at the pars pylorica. A crater was demonstrated at the gastrojejunostomy.

An operation was performed shortly thereafter, at which the roentgen findings were confirmed. The volvulus was found to be caused by extensive adhesions. The ulcer, as well as the greater portion of the stomach, was resected. The patient made an uneventful recovery, with comparatively normal postoperative findings on a repeat gastrointestinal series five months later.

Organo-axial Volvulus, Secondary to Duodenal Ulcer.

Case ix (Fig. 9). A.G., a seventy-two year old male, with Laennec's cirrhosis and arteriosclerotic heart disease. His gastrointestinal symptoms consisted of anorexia, nausea and vomiting of two weeks' duration with gradual weight loss.

Roentgen examination showed partial organo-axial volvulus, rotation occurring along the organic axis. The bulb was deformed and irregular, with a niche suggesting a duodenal ulcer. There was no hiatus hernia. Additional findings were a large liver and diverticulitis of the sigmoid. The patient was treated medically.

D. *Organo-axial Volvulus, Secondary to Colonic Diverticulitis.*

Case x (Fig. 10). S.L., a seventy-one year old male, was admitted to the University Hospital on March 13, 1950, complaining of abdominal

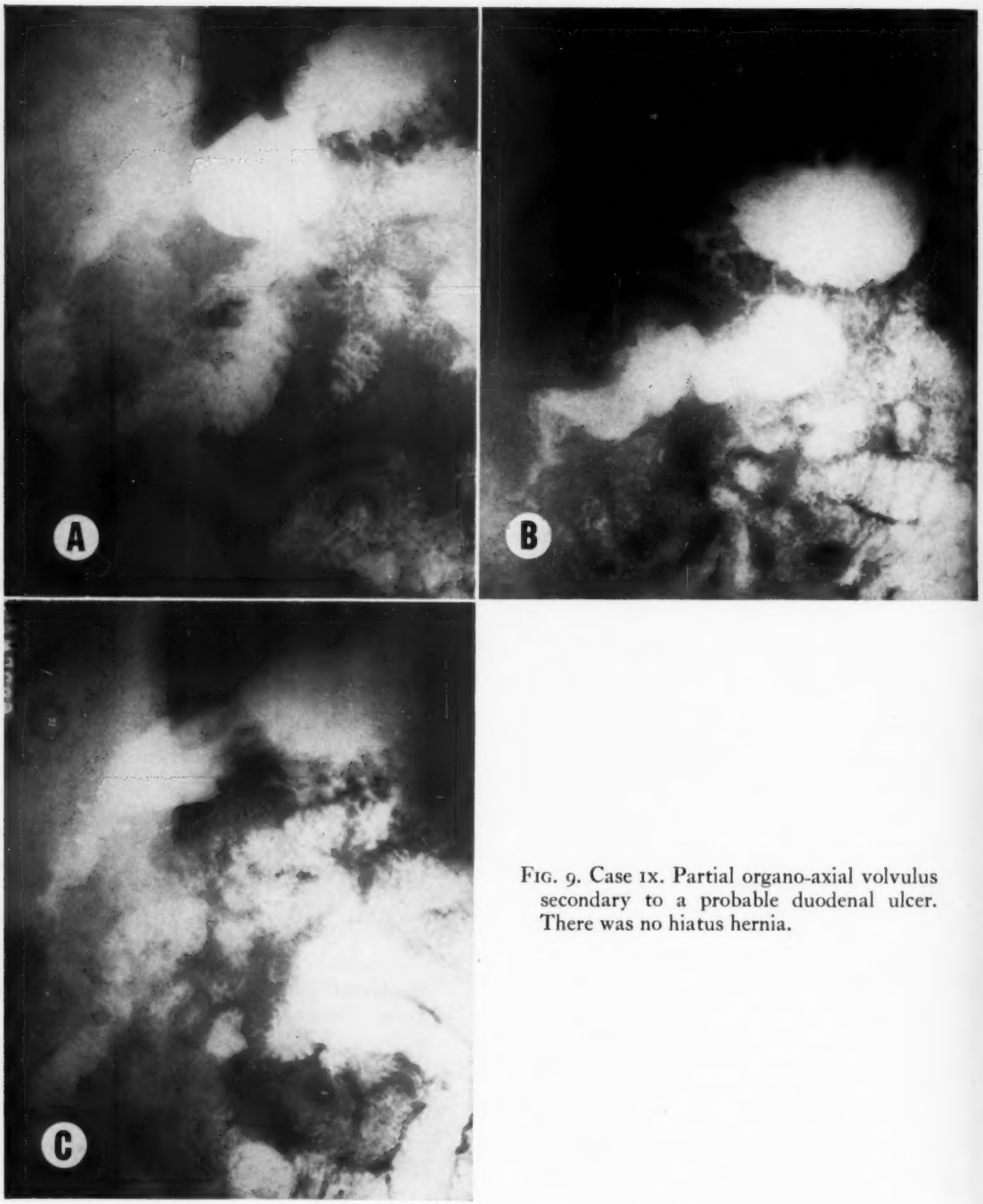


FIG. 9. Case IX. Partial organo-axial volvulus secondary to a probable duodenal ulcer. There was no hiatus hernia.

pain and gaseous distention of one week's duration. The pain originated in the epigastrium but extended down to the left lower quadrant. Bowel movements were normal, but "golden" in color.

The first roentgen examination was a routine chest, which revealed hepatodiaphragmatic interposition. Subsequent cholecystography presented evidence of fluid levels in the upright ascribable to intestinal obstruction. The hepatodiaphragmatic interposition was no longer present. A barium enema showed an irregular filling defect in the sigmoid, with evidence of ileocolic fistula (not shown in submitted films).

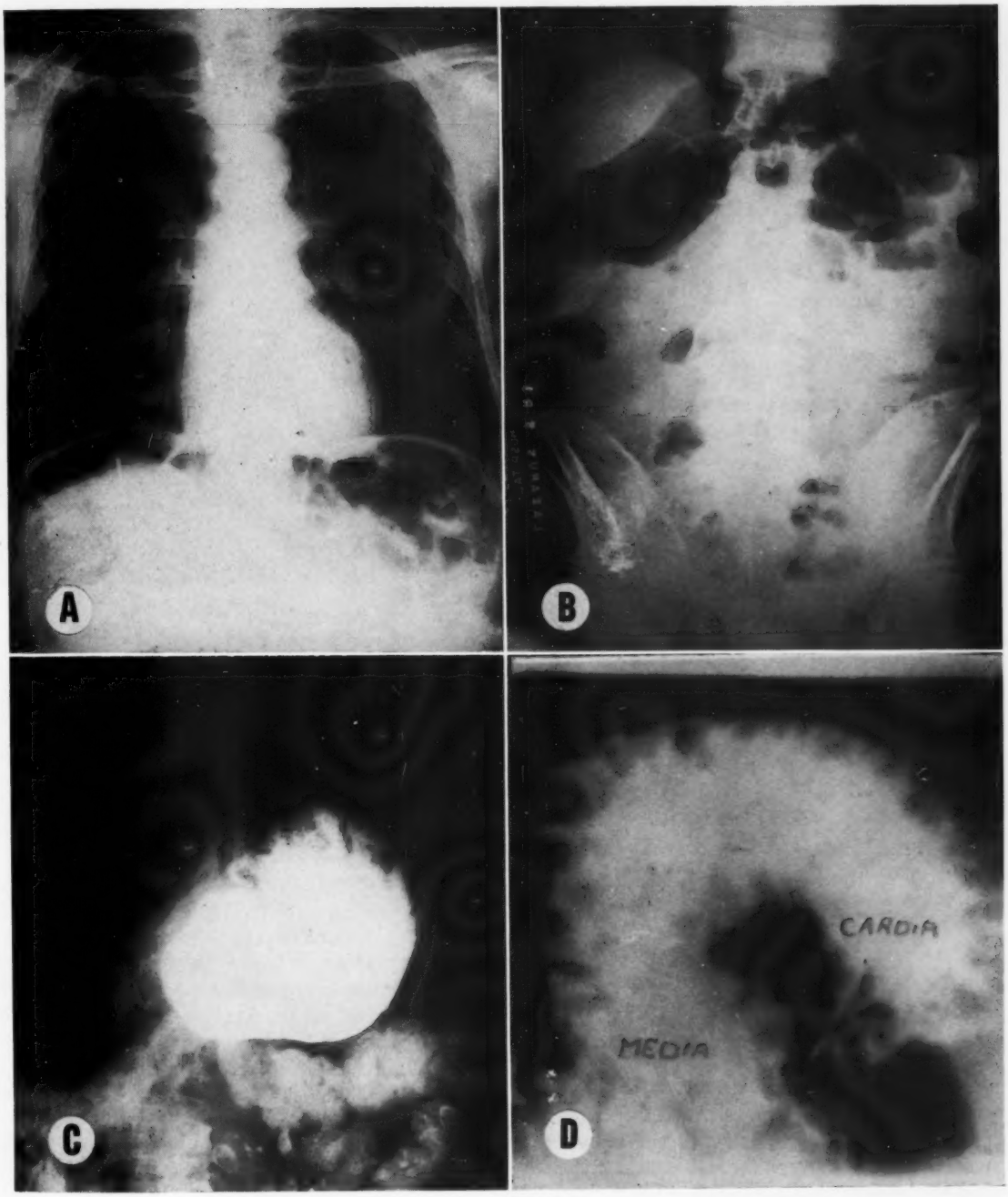


Fig. 10. Case x. Organo-axial volvulus secondary to adhesions and diverticulitis of the sigmoid with ileo-colonic fistula. In (*A*) hepatodiaphragmatic interposition of the colon is demonstrated. (*B*) is a later film taken in the upright position during cholecystography, and shows the colon still high, but no longer between the liver and diaphragm. A film (*C*) of the barium-filled stomach shows a twist along the organo-axial plane which is clearly demonstrated in the oblique spot view in (*D*). Note the sac-like appearance of the twisted stomach in the rare infracolic position.

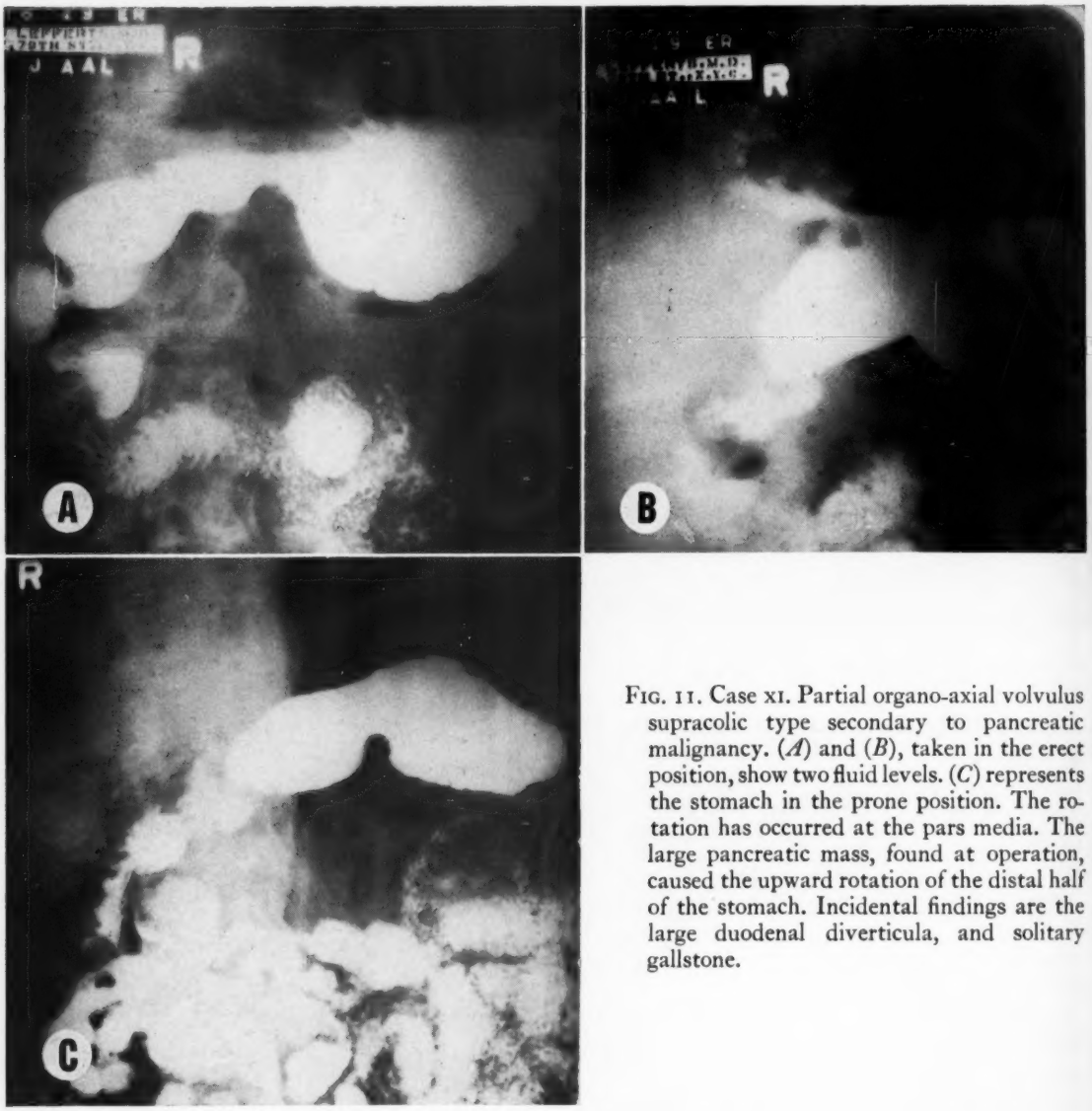


Fig. 11. Case xi. Partial organo-axial volvulus supracolic type secondary to pancreatic malignancy. (*A*) and (*B*), taken in the erect position, show two fluid levels. (*C*) represents the stomach in the prone position. The rotation has occurred at the pars media. The large pancreatic mass, found at operation, caused the upward rotation of the distal half of the stomach. Incidental findings are the large duodenal diverticula, and solitary gallstone.

There were multiple diverticula of the colon. A week after admission a gastrointestinal series was performed. Although the colon was not under the diaphragm, it was still above the main body of the stomach, and in close relationship to the pars cardia. The stomach rotates on its organic axis at this point. This is an example of an infracolic type of organo-axial volvulus, which is quite rare.

The patient was treated medically with decompression and antibiotics. He improved considerably until the eighteenth hospital day, when he developed thrombophlebitis in his left lower extremity, and died suddenly.

Postmortem examination revealed extensive diverticulitis in the descending colon and sigmoid, with an ileocolic fistula, and adhesions. The cause of death was extensive hemorrhage into both adrenals. The stomach and colon were normal in outline and position, the stomach being below the colon.

This lack of postmortem evidence of volvulus should not be taken as a denial of this diagnosis. It has been shown that volvulus is intermittent, and this patient had been under decompression therapy for eighteen days.

E. *Organo-axial Volvulus, Secondary to Pancreatic Malignancy.*

Case xi (Fig. 11). J.A., a sixty-eight year old male, with intermittent epigastric distress for twenty-eight years. The pain increased in in-

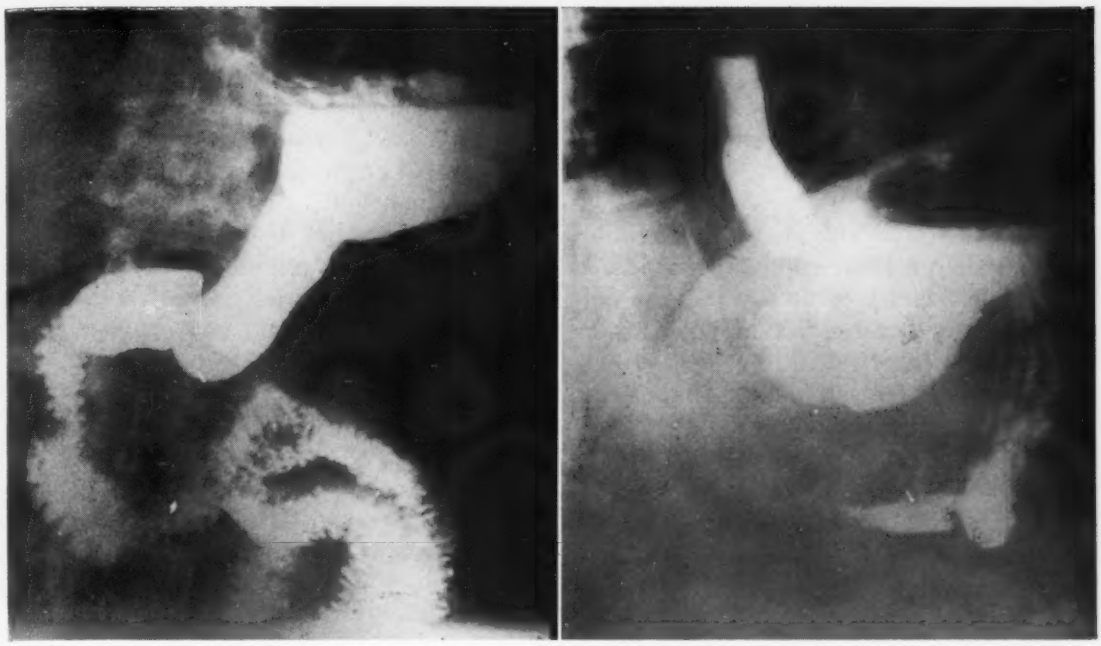


Fig. 12. Demonstration of an uncomplicated cascade stomach.

tensity, with 15 pound weight loss in the last four weeks prior to examination in June, 1949. The roentgen findings showed an organo-axial volvulus of the stomach, with a large posterior cascade of the cardiac pouch. Two fluid levels were present in the upright view. This volvulus is of the supracolic type. No ulcer or malignancy was demonstrated. The large duodenal diverticulum and the gallstone were incidental findings.

The patient's condition continued to be retrogressive, and he finally came to operation a few weeks later. A large malignant mass was found, involving the body of the pancreas. The stomach was rotated on its organic axis as demonstrated roentgenographically. The neoplasm was firmly adherent to the stomach and adjacent structures. A gastroenterostomy was performed. The patient died shortly thereafter. No postmortem was obtained.

Case xii. This case has been presented earlier as Case 11 (Fig. 2) as an example of organo-axial volvulus secondary to eventration of the diaphragm. This case may well be classified also as secondary to pancreatic neoplasm.

DISCUSSION

The differential diagnosis of the organo-axial type of volvulus from simple cascade action of the pars cardia may at times be extremely difficult. Azmy and Marey have been quoted in Part I as believing that this type of volvulus is an exaggerated cascade stomach. An example of an extreme cascade, but not actual volvulus is shown in Figure 12. The following features are important in differential diagnosis:

1. One fluid level in cascade action, two in volvulus.

2. The greater curvature is not uppermost in cascade action, whereas it is in volvulus.

3. In volvulus the uppermost rotated greater curvature forms a convex curve continuous with the duodenum, simulating an apparently enlarged sweep of the duodenum. In cascade action the relationships are normal, with the greater curvature being lowermost and *not* forming a continuous convex curve. The duodenal loop is normal.

4. The entrance of the esophagus in cascade stomach is in its normal position, just below the diaphragm. The unusual and low position of the cardiac orifice in volvulus due to rotation is best illustrated in Figure 1.

CONCLUSIONS

1. Gastric volvulus is, in our experience,

more frequent than is generally recognized.

2. In all cases of acute conditions of the abdomen, where a definite diagnosis cannot be made, volvulus should be considered, especially when the Borchardt and Lenormant's triad of symptoms (see Part II) are present.

3. Organo-axial volvulus is much more frequent than mesentero-axial volvulus. In the twenty cases presented, there are only three cases of mesentero-axial volvulus, all idiopathic in type.

4. The differential diagnosis between these two types of volvulus and cascade stomach are briefly illustrated and discussed.

5. The etiological relationship of the colon should always be investigated in all cases of volvulus. The transverse colon is high in the epigastrium closely related to the stomach. Two of our cases show the presence of hepatodiaphragmatic interposition of the colon.

6. In our series the supracolic type of volvulus is more prevalent, the infracolic type is rare. Our series presents four infracolic type of volvulus, two of them with hepatodiaphragmatic interposition.

Samuel L. Beranbaum, M.D.
University Hospital
303 East 20th St.
New York 3, New York

Vol. 72, No. 4

THE ROENTGEN DIAGNOSIS OF GALLBLADDER AND BILIARY TRACT DISEASE WITHOUT CHOLECYSTOGRAPHY*

By ROBERT L. SCANLAN, M.D., *and* BARTON R. YOUNG, M.D.
PHILADELPHIA, PENNSYLVANIA

A GREAT deal of information concerning gallbladder and biliary tract disease is available on conventional films, without the aid of cholecystography. Films of the abdomen frequently reveal biliary tract disease, often unsuspected and significant, as was emphasized before the advent of cholecystography.[4] A recent review by Stevenson[10] showed that conventional films of the abdomen were of value in 40 per cent of their cases of cholecystitis. Impacted or duct stone, distended gallbladder, or air in the biliary tract are not uncommonly demonstrated.

Opaque calculus is the simplest manifestation of biliary disease (Fig. 1*A*). Less than one-fifth of calculi contain sufficient calcium to be recognized on roentgenograms of the abdomen. A poorly opaque stone may be identified by a stellate radiolucency produced by air in central crevices, permitting a diagnosis of cholelithiasis, without the use of a contrast medium[5] (Fig. 1*B*). Position and movement of calculi yield valuable information concerning their cholecystic or duct location, gallbladder size, and possible obstruction of the duct system. Either wide separation or movement indicates an enlarged gallbladder, in contrast to the minimal motion of tightly bunched stones in an average-sized or contracted gallbladder (Fig. 2). Movement of calculi is revealed by examination of the patient in different positions. Lack of motion of a stone in the region of the neck of the gallbladder suggests impaction or a duct stone (Fig. 2). A stone in the common or cystic duct may be suspected because of its location (Fig. 1*A*).

Calcification in the abdomen having the appearance of gallstones suggests perforation of the gallbladder with escape of stones into the peritoneal cavity or alimentary tract. Gallstones have been recovered also from the urinary bladder, vagina, pregnant uterus, abdominal wall, pleural and pericardial cavities and the bronchial tree.[2] Gallstones occasionally obstruct either the large or small intestine and may be demonstrated by their calcium content or by intestinal gas.[9] Both the obstructing stone and its fistulous tract have been demonstrated by barium sulfate in the small intestine.[3] Multiple stones may produce obstruction at different sites and should be sought for, particularly when one of the stones is faceted.

Stone in the cystic duct is occasionally associated with an opaque density in a contracted, thickened gallbladder, so-called "milk of calcium bile."[6] It is thought that the calcium carbonate is secreted and concentrated by an obstructed gallbladder, often blocked by a small stone with an opaque periphery.[7] At times the opacity is confined to the cholecystic aspect of the stone. The material varies in consistency from fluid to solid, and in one patient a concretion formed from liquid milk of calcium bile in nineteen days.[1] Concentration of contrast medium in the gallbladder with an opaque cystic duct stone and a milk of calcium bile concretion was recently observed, indicating incomplete obstruction by the duct stone. Calcification in the gallbladder wall must be differentiated from a stone with an opaque periphery or a calcified abscess in the lower border of the liver. It is possibly the sequel of a hemorrhagic cholecystitis and is always associated with cholelithiasis.

A visualized gallbladder is usually an

* From the Department of Radiology, Germantown Hospital, Philadelphia, Pennsylvania.

Fig. 1. Stones in the gallbladder, cystic and common ducts indicated by their positions (*A*). Gallbladder wall is thickened. Characteristic stellate radiolucencies of gas-containing gallstones permit a diagnosis of cholelithiasis on conventional film examination (*B*) (arrows).

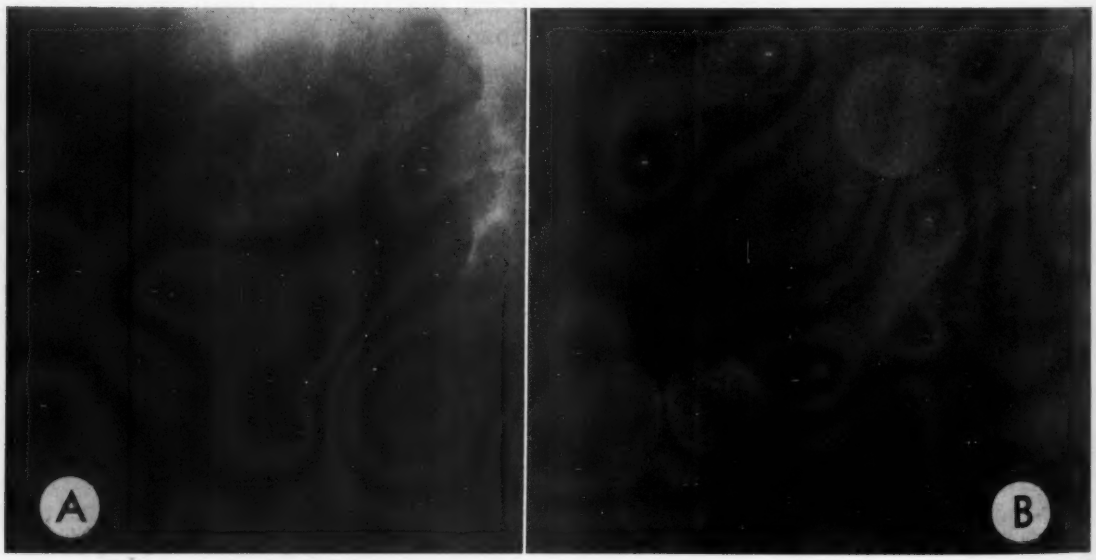


Fig. 2. (*A*) and (*B*) Wide range of movement of gallstones on prone and supine films demonstrates enlarged gallbladder. Lack of motion of the superior stone reveals its impaction in the cystic duct. Note stellate gas shadows in stones.

indication of significant disease, although a normal gallbladder shadow can occasionally be identified without the use of contrast medium. Therefore, a diagnosis of cholecystic disease should not be suggested on the basis of visualization alone. The visualized gallbladder is usually demonstrated as an enlarged oval soft tissue mass, but occasionally the reverse is true, and a contracted thickened gallbladder is seen (Fig. 1*A*). The kidney and liver edge must always be identified before soft tissue density is interpreted as gallbladder. When this is not possible on conventional films, additional procedures such as cholecystography, intravenous urography, and planigraphy are of aid. The lower margin of an abnormally dense gallbladder shadow is frequently outlined by gas in the contiguous intestine (Fig. 3*A*). Intestinal gas is often excessive, because of adjacent ileus secondary to cholecystic and peritoneal inflammation. Indentation of barium-filled intestine does not in itself indicate a diseased gallbladder. There must be associated evidence such as soft tissue mass or cholelithiasis (Fig. 3*B*). Enlarged gallbladder must be differentiated from tumefactions of the liver, choledochal cyst, and subhepatic abscess. Distention of the gallbladder may indicate obstruction of the common duct rather than cholecystic disease.

Gas in the gallbladder or biliary tract usually indicates an abnormal communication with the intestine, most frequently caused by erosion of a gallstone into the intestinal tract. The resulting fistula allows intestinal gas to pass into the biliary tract and rarely into the pancreatic ducts (Fig. 4). A surgical anastomosis of the gallbladder or common duct to the intestine permits gas to ascend into these areas. Less common causes are rupture of an ulcer into the biliary tract and incompetence of the ampulla due to carcinoma, pancreatitis or recent passage of a stone. Occasionally, barium enters the fistulous tract or regurgitates into the common duct through an incompetent sphincter during a gastrointestinal study (Fig. 5).

Emphysema of the gallbladder presents a distinctive roentgen appearance, because its walls and lumen are outlined by gas resulting from infection by gas-producing organisms[8] (Fig. 6). Ileus of adjacent loops of small intestine secondary to localized

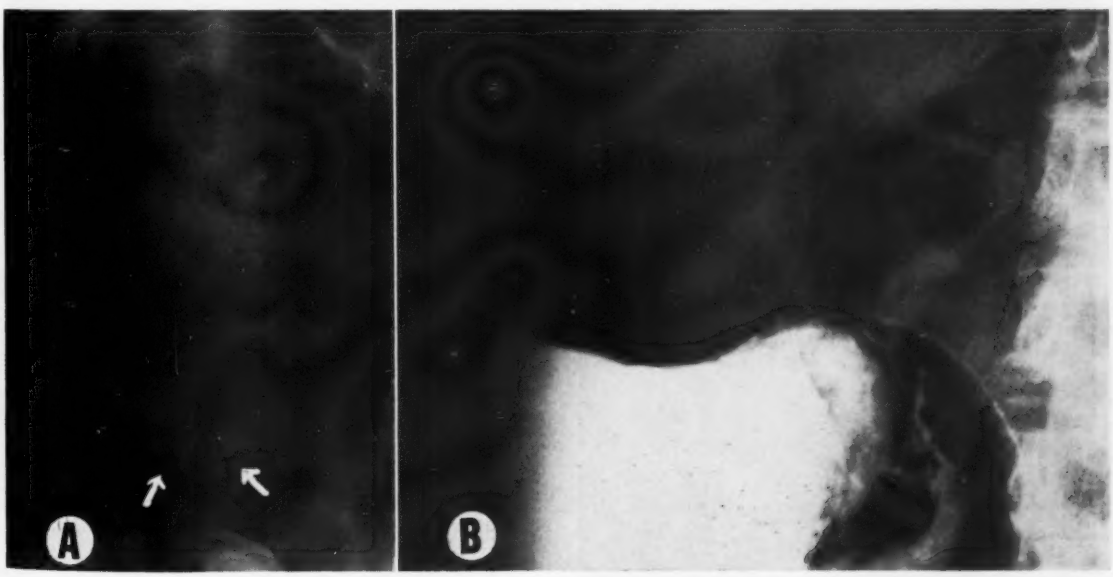


Fig. 3. (*A*) Huge gallbladder outlined by contiguous gas-filled intestine with localized ileus. (*B*) Hepatic flexure indented by enlarged gallbladder.

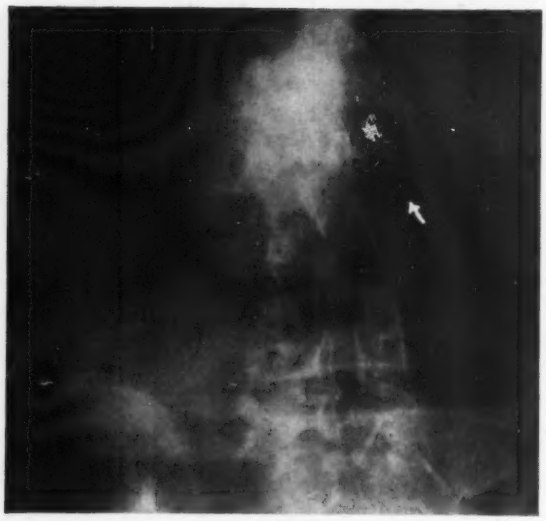


FIG. 4. Air in biliary and pancreatic ducts, plus small intestinal obstruction due to perforated gallbladder and gallstone ileus (arrows).

peritonitis is not infrequently an accompanying finding. A high proportion of patients with gallbladder emphysema are diabetic.

Gas first appears in the lumen of the gallbladder and is demonstrable by horizontal beam film examination. Bubbles are next seen in the gallbladder wall and pericholecystic tissues in contrast to the appearance in biliary-intestinal fistula. In the latter, gas is not seen in the gallbladder wall. Gas thought to be in the bile ducts must be differentiated from linear collections behind the liver, secondary to retroperitoneal rupture of the appendix or distal colon. Gas in the gallbladder may be simulated by a large air-filled diverticulum and by subhepatic collections following perforation of an ulcer.

The roentgen technique was perfected prior to the advent of cholecystography. Detailed descriptions are largely applicable to the present technique and are to be found in the literature of that period.[4] Short exposure time made possible by present-day equipment contributes to the sharpness of the image. We have employed large-sized films for complete coverage of the abdomen, supplemented by sharply coned films of the gallbladder, when disease of this area is suspected. Prone, supine and lateral decubitus roentgenograms, the last with the horizontal beam, are invaluable in

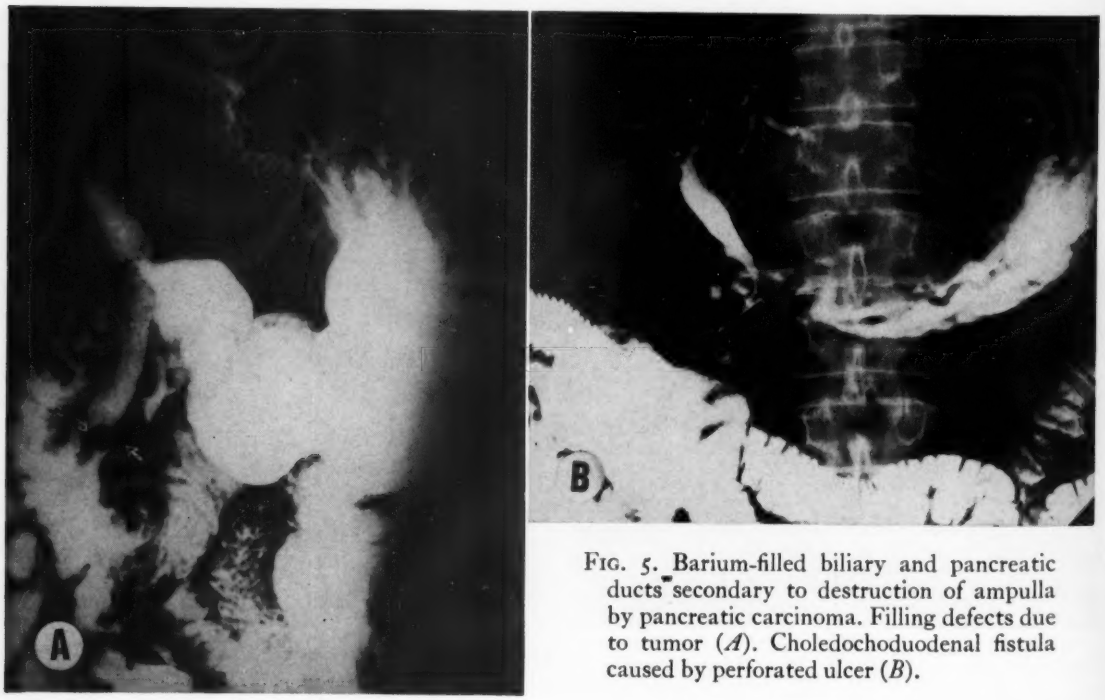


FIG. 5. Barium-filled biliary and pancreatic ducts secondary to destruction of ampulla by pancreatic carcinoma. Filling defects due to tumor (*A*). Choledochoduodenal fistula caused by perforated ulcer (*B*).

the demonstration of calculus, enlarged gallbladder, and gas in the biliary tract. These views are obtained routinely in an examination of the acute abdomen, and are more informative than any single projection. The distribution of gas and stones is different on each of these films, affording a better opportunity for delineation of biliary tract disease (Fig. 2). Roentgenograms taken in lateral decubitus are said to be of particular value in the demonstration of gas secondary to biliary fistula, but in our experience the optimal projection varies with the location of the fistula.

CONCLUSIONS

Conventional roentgenograms without the aid of cholecystography often reveal valuable information concerning gallbladder and biliary tract disease. The arrangement and range of movement of stones may be the only indication of a distended gallbladder or duct calculi. An enlarged gallbladder indicating cholecystic or ampullary disease may be of sufficient opacity for detection and the inferior margin is frequently outlined by contiguous gas-filled loops of intestine. Air in the biliary tract indicates abnormal communication with the intestinal tract or infection with gas-forming organisms. Prone, supine and lateral decubitus views have been an invaluable combination far superior to any single projection in the roentgen diagnosis of gallbladder and biliary tract disease without cholecystography.

Barton R. Young, M.D.
Germantown Hospital
Philadelphia 44, Pennsylvania

Fig. 6. Emphysematous gangrenous gallbladder resulting from infection by gas-forming organisms. Note associated localized ileus.

REFERENCES

1. Báron, Julius. Roentgenologic observation of formation of calcium carbonate gallstone. *Radiology*, 1940, *35*, 741–742.
2. Epperson, D. P., and Walters, W. Spontaneous internal biliary fistulas. *Proc. Staff Meet., Mayo Clin.*, 1953, *28*, 353–360.
3. Garland, L. H., and Brown, J. M. Roentgen diagnosis of spontaneous internal biliary fistulae, especially those involving common duct. *Radiology*, 1942, *38*, 154–159.
4. George, A. W., and Leonard, R. D. The Pathological Gall-Bladder Roentgenologically Considered. Paul B. Hoeber, Inc., New York, 1922.
5. Hinkel, C. L. Gas-containing biliary calculi. Am. J. Roentgenol. & Rad. Therapy, 1950, *64*, 617–623.
6. Knutsson, F. On limy bile. *Acta radiol.*, 1933, *14*, 453–462.
7. Perry, S. P., and Carpender, J. W. J. Significance of calcification in gallbladder. *Pennsylvania M. J.*, 1942, *45*, 477–481.
8. Qvist, C. F. Cholecystitis emphysematosa. *Acta radiol.*, 1951, *35*, 200–206.
9. Rigler, L. G., Borman, C. N., and Noble, J. T. Gallstone obstruction; pathogenesis and roentgen manifestations. *J.A.M.A.*, 1941, *117*, 1753–1759.
10. Stevenson, C. A. Roentgenologic examination of gallbladder without opacification. *J.A.M.A.* 1953, *151*, 264–265.

LEIOMYOSARCOMA OF THE PROSTATE*

CASE REPORT

By RALPH C. AYE,† M.D., THOMAS W. DORR,† *and* NOEL G. SHAW, M.D.,‡
EVANSTON, ILLINOIS

SOME 200 cases of sarcoma of the prostate gland have appeared in the literature to 1943 according to the complete review of the subject by Melicow, Pelton and Fish.[3] Since then about 30 additional cases have been described. Barone and Joelson[1] reported the sixteenth case of leiomyosarcoma of the prostate in 1950. Many types of tumor have been demonstrated and these include fibrosarcoma, lymphosarcoma, angiosarcoma, myxosarcoma, rhabdomyosarcoma, spindle cell sarcoma, and a carcinoma existing concurrently in the same gland.[4]

The etiology is unknown. The neoplasm arises from the mesodermal layer; probably it springs from smooth muscle but other prostatic elements such as fibrous tissue, interstitial lymphoid foci and vascular components are possible points of origin. Lowsley and Kimball[2] state that embryonal disturbances may be a factor. Trauma and prostatitis have been suggested.

The age incidence ranges from neonatal infants to ninety year old men, but 75 per cent of these tumors are seen in patients under forty years of age and one-half occur in patients under twenty. It is repeated many times in the literature that prostatic masses seen in young males are to be considered sarcomatous until proved otherwise.

Symptoms are those of any vesicle neck obstruction and include frequency, nocturia and dysuria, although pain is often absent. The tumor may be extremely rapidly growing, as, for example, in the case presented, the tumor was almost entirely removed at operation yet three weeks later a large mass was palpated in the abdomen. Sudden urinary retention by a rapidly growing neoplastic mass or blood clots may occur, especially in the young. Extension of the tumor produces symptoms of advanced urinary obstruction, rectal pressure and difficult defecation. Rectal examination demonstrates a soft, smooth, rubbery mass which is not fixed at first. Roentgen examination may show a noncharacteristic mass in the pelvis or abdomen which displaces the viscera; a barium enema or meal may serve to define a small mass but the plain film of the abdomen will usualy exhibit the tumor. Descending urography will also demonstrate the mass by a declivity of one or both of the ureters, elevation and distortion of the bladder and signs of obstruction. The serum acid and alkaline phosphatase are normal; azotemia may be present and is the common cause of death.

Diagnosis is rarely made before biopsy or necropsy. Differentiation must be made among the following: benign prostatic hypertrophy, prostatic abscess or cyst, tuberculosis of the prostate, carcinoma of the prostate, carcinoma and sarcoma of the bladder, cyst of the seminal vesicle, urachal cyst and retroperitoneal tumor. Treatment may prolong life but is usually hopeless. The most widely used treatment is deep roentgen therapy or radium implants, with surgery reserved for relief of bowel or urinary obstruction. Metastases occur via the blood and lymph channels and appear commonly in the bone and lung, less commonly in the liver, kidneys, regional lymph nodes and spleen.

CASE REPORT

A one year old, white, male infant entered the pediatric service of Evanston Hospital on July 28, 1952, because of dysuria for two weeks

* From the Departments of Radiology and Pediatrics, Evanston Hospital Association, Evanston, Illinois.
† Resident in Radiology, Evanston Hospital Association, Evanston, Illinois.
‡ Clinical Assistant Professor of Pediatrics, Rush, University of Illinois.

and frequency for one week. On the day of admission the child voided every hour. No gross hematuria was noted by the parents. Concerning the past history, the patient was a full term infant, delivery was by forceps with vertex presenting. The birth weight was 7 pounds, 11 ounces. The child developed normally. The immunization program was completed. The family history was negative.

On physical examination the child was a well developed and nourished, irritable, male infant who did not appear acutely ill. The thorax was normal. In the abdomen there was a kidney-shaped mass on the left which was nontender. The liver was palpable one finger-breadth below the costal margin. The spleen was not palpable. The neurological examination was considered normal. The clinical impression at admission was (1) cystitis, (2) possible Wilms' tumor, (3) urachal cyst, (4) mesenteric cyst and (5) sarcoma in the abdomen. The child was seen by a surgeon and a urologist who believed the most likely diagnosis to be a urachal cyst.

Roentgen examination with plain films of the abdomen and a barium meal demonstrated a large mass in the lower abdomen which displaced the colon posteriorly and the small intestine superiorly; this suggested that the mass was not of retroperitoneal origin (Fig. 1 and 2); descending urography showed normal renal function bilaterally and wide lateral displacement of the lower portions of both ureters with elevation of the bladder (Fig. 3). A chest film was negative.

Fig. 1. Abdomen shows viscera-displacing tumor mass following a barium meal.

Fig. 2. Lateral projection.

Laboratory examination showed the following: red blood cell count, 4 million; white blood cell count, 10,000; hb, 11 grams. No red cells were noted in the urine but culture exhibited a moderate growth of *Strep. viridans*, *E. coli* and *Staph. albus*.

An exploratory laparotomy was performed and a large, soft tumor attached to the base of the bladder was found. The superior and lateral parts were free; both ureters and urethra were compressed and these were freed and the mass excised. Section of the tumor proved it to be a leiomyosarcoma of the prostate (Fig. 4 and 5). The postoperative course was uneventful and the child was discharged on August 11, 1952. Seventeen days later the child was readmitted because of difficulty in defecation, vomiting and night crying for several days. A rectal examination disclosed a recurrence of the tumor. Chest films were normal. It was felt that the prognosis was hopeless and the patient was

FIG. 3. Descending urography fifteen minutes following intravenous diodrast demonstrates the mass symmetrically displacing the ureters.

treated symptomatically. The child's condition deteriorated and he died in coma on September 11, 1952.

At postmortem examination, the child was not emaciated but the lower half of the abdomen was distended by a large, firm mass. The neoplasm surrounded both ureters causing marked ureterectasis and pyelectasis, occluded the prostatic urethra, and involved the anterior wall of the rectum (Fig. 6). Distention of the large and small intestine plus moderate ascites indicated the presence of a paralytic ileus. The immediate cause of death was surmised to be uremia, although no chemistries were determined. Metastases were not found.

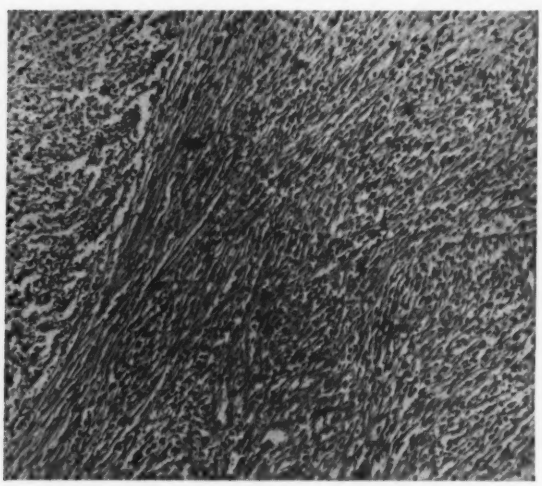


FIG. 4. Photomicrograph, low power, illustrating the spindle-shaped appearance of tumor cells and bundles of intertwining tumor tissue.

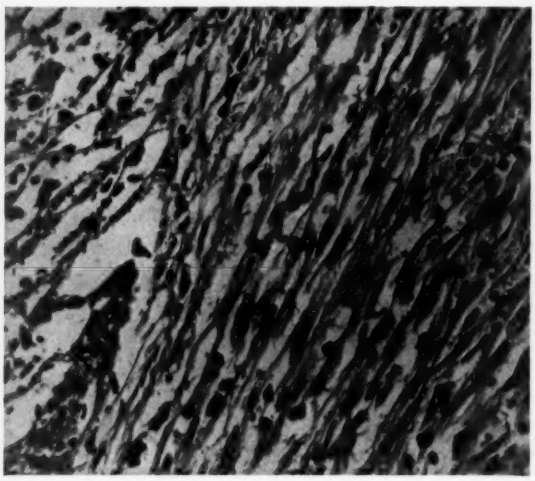


FIG. 5. High power view of section of tumor.

FIG. 6. Gross specimen with probes in ureters and black tube in urethra shows tumor engulfing vesicle portion of both ureters.

SUMMARY

A rare, fatal tumor, leiomyosarcoma of the prostate, is described in a year old infant. Roentgenograms may show a pelvic mass and urography will demonstrate a distortion of the ureters and bladder. The salient characteristics of this tumor are briefly described.

Ralph C. Aye, M.D.
2650 Ridge Ave.
Evanston, Illinois

REFERENCES

1. Barone, A. M., and Joelson, J. J. Leiomyosarcoma of prostate. *J. Urol.*, 1950, *63*, 533–538.
2. Lowsley, O. S., and Kimball, F. N. Sarcoma of prostate. *J.A.M.A.*, 1934, *103*, 983–985.
3. Melicow, M. M., Pelton, T. H., and Fish, G. W. Sarcoma of prostate gland; review of literature; table of classification; report of 4 cases. *J. Urol.*, 1943, *49*, 675–707.
4. Merren, D. D., and Credle, W. S. Multiple malignancies of prostate. *J. Urol.*, 1950, *64*, 758–762.

VISUALIZATION OF CORONARY SINUS GRAFT AND VENOUS PATHWAYS OF THE HEART IN LIVING DOGS*†

By ARAN S. JOHNSON, M.D., PAUL G. FIRNSCHILD, M.D., *and* HAROLD FULTON, M.D.
DETROIT, MICHIGAN

BECK and his associates[7] have demonstrated that the heart in the experimental animal and in patients suffering from coronary artery disease can be revascularized by arterialization of the coronary sinus through a free autogenous vein graft anastomosed between the aorta and coronary sinus. The operation described and developed by Beck is called the Beck II operation. The operation consists of two stages.[5] In the first stage, the free graft of external jugular or basilic vein is anastomosed between the aorta and coronary sinus. The stoma of the graft on the sinus side measures approximately 8 millimeters in diameter, and on the aortic end of the anastomosis the stoma is 5 to 6 mm. in diameter. After the completion of the first stage, blood flows freely from the aorta through the graft and into the venous system of the heart. Most of the arterialized blood escapes into the right atrium through the coronary sinus ostium. In order to prevent the great loss of blood and to reduce the added load on the right side of the heart, the second stage was developed. The second stage of the operation is done three weeks after the first stage. It consists of placing a ligature around the sinus near its ostium in the right atrium. The ligature is tied down on a stilet to a diameter of 2.5 or 3 mm. According to the authors,[5] the rationale of waiting three weeks to partially ligate the coronary sinus ostium is to prevent rupture of the veins and capillaries in the heart from the full application of the aortic pressure. The time interval is sufficient to produce thickening of the walls of the veins and capillaries.

In our study it was our original aim to find a simple method without a major operation to determine the patency of the coronary sinus graft and venous pathways of the heart in the living dog. In a large number of animals, postoperatively, a to and fro bruit is present which is a sign of a functioning arteriovenous fistula. The finding, however, is not constant, especially in patients, and therefore cannot be used as a foolproof sign of patency of the graft. It is only during the second stage of the Beck II operation, under direct vision, that the condition of the graft can be determined, *i.e.*, if the graft is thrombosed or patent. We were able through retrograde aortography to visualize the coronary sinus graft and also gain valuable information pertaining to the Beck II operation.

METHOD OF STUDY

This report is based upon a study of 30 male mongrel dogs. The animals weighed between 26 and 57 pounds. The Beck operation was performed. The animals, however, were divided into three operative groups: (1) those animals on whom Stage I alone was done; (2) those animals on whom Stage I was done followed by a three week waiting period, and then Stage II; (3) those animals on whom Stages I and II were accomplished during the same operation. Postoperative retrograde aortography was done on 9 of the 30 dogs. Four of these animals had developed postoperative bruits, while 5 had not. These animals were anesthetized with intravenous nembutal, the left common carotid artery was then exposed and the animals were taken to the roentgen department. Through a 15 gauge needle 70 per cent urokon (1 cc. per lb. of body weight) was injected rapidly retrograde into the left common carotid artery. At the time of injection the distal end of the left common carotid artery

* From the Department of Animal Experimentation, Research Division, and Department of Radiology, Harper Hospital, Detroit, Michigan.
† Aided by a Grant for Cardiovascular Research from the C. E. Wilson Fund.

was occluded, as well as the right. A series of eight roentgenograms was then exposed within a period of four seconds, *i.e.*, one-half second intervals. Postoperative aortography was carried out on animals at intervals ranging from the fourth postoperative day to the twenty-eighth postoperative day. Nineteen of the 30 animals with the coronary sinus grafts were placed on intramuscular daily digitalis (0.2 to 0.4 mm. cedalinid once daily) for two to three weeks postoperatively, depending upon the clinical need for the drug. Eleven of the animals received no digitalis.

RESULTS

Twenty-two of the animals developed persistent postoperative bruits, which were the result of the created arteriovenous fistulas, while 8 did not. It was noted at the completion of all the operations, except in 1 animal,* that a palpable thrill was present in the grafts with transmission into the coronary sinus, with a pinking of the anterior cardiac veins.

FIG. 1. Animal B2 20. Retrograde carotid aortogram. Descending thoracic aorta (*a*), graft (*b*), coronary sinus (*c*), and right atrium into which coronary sinus empties (*d*) are demonstrated.

FIG. 2. Animal B2 20. Marginal veins filling from coronary sinus are visualized (arrow).

Eight of the animals in the series died from congestive heart failure. All were in Group 1, and received no digitalis postoperatively. The size of their grafts was 7 to 10 mm. in diameter.

Nineteen of the operated animals, in Groups 1, 2 and 3, received daily doses of intramuscular digitalis. These animals had an uneventful postoperative course. The size of their grafts varied from 4 to 8 mm. in diameter. One animal in this series died on the sixth postoperative day from gross hemorrhage. There was a leak on the coronary sinus side of the anastomosis. Three animals in Group 2 also had uneventful postoperative convalescence without the benefit of digitalis. The size of their grafts, however, was smaller (5 to 6 mm.).

* Unable to isolate coronary sinus in this animal. See Table 1, animal 22.

TABLE I

STATISTICAL DATA ON THE THIRTY DOGS WITH CORONARY SINUS GRAFTS

Dog No.	Wt. lb.	Free Auto Vein	Length of Graft	Dia. of Graft	Stage of Operation	Post-operative Beck Murmur	Post-operative Digitalis	Post-operative Day Aortography	Result of Aortography	Duration of Graft (days)	Cause of Death	Remarks
1	45	Ext. jug.	4.5	8	1	Yes	No	—	—	5	Cong. ht. failure	P.M.: patent graft, diffuse myocardial congestion, pulmonary congestion
2	48	Ext. jug.	4	8	1	Yes	No	—	—	3	Cong. ht. failure	P.M.: patent graft, diffuse myocardial congestion, pulmonary congestion
3	32	Ext. jug.	3	5	I–II	No	No	—	—	32	S	P.M.: patent graft
4	34	Ext. jug.	3	5	I–II	Yes	No	—	—	40	S	P.M.: patent graft
5	35	Ext. jug.	2.5	6	I–II	Yes	No	—	—	60	S	P.M.: patent graft
6	30	Ext. jug.	3	7	1	Yes	No	—	—	11	Cong. ht. failure	P.M.: patent graft, small areas of myocardial congestion, pulmonary congestion, pleural effusion
7	34	Ext. jug.	3	7	1	Yes	Yes	—	—	28	S	P.M.: patent graft
8	25	Ext. jug.	2.5	6	I–II	No	Yes	—	—	68	S	P.M.: patent graft
9	41	Ext. jug.	3.2	8	1	Yes	No	—	—	8	Cong. ht. failure	P.M.: patent graft, diffuse myocardial congestion, pulmonary congestion
10	32	Ext. jug.	3	7	1	Yes	No	—	—	3	Cong. ht. failure	P.M.: patent graft, diffuse myocardial congestion, pulmonary congestion
11	28	Ext. jug.	2.5	5	I–II	No	Yes	—	—	35	S	P.M.: patent graft
12	49	Ext. jug.	3	7	1	Yes	Yes	4th	Patent graft	5	GH	P.M.: ruptured graft at site of coronary sinus anastomomis; hemothorax; patent graft. died 24 hrs. after aortog.
13	38	Ext. jug.	3	7	1	Yes	Yes	12th and 20th	Patent graft	48	S	P.M.: patent graft. Aortography; coronary sinus graft patent and venous pathways of the heart
14	26	Ext. jug.	3	5	I–II	No	Yes	14th	Patent graft	75	S	P.M.: patent graft. Aortography: coronary sinus graft patent and venous pathways of the heart
15	44	Ext. jug.	3	8	1	Yes	No	—	—	3	Cong. ht. failure	P.M.: patent graft, myocardial congestion, pulmonary congestion
16	32	Ext. jug.	3	7	1	Yes	No	—	—	4	Cong. ht. failure	P.M.: patent graft, myocardial congestion, pulmonary cong., pleural effusion
17	57	Ext. jug.	3.3	10	1	Yes	No	—	—	4	Cong. ht. failure	P.M.: patent graft, myocardial cong., pulmonary cong., pleural effusion
18	36	Ext. jug.	3	6	1	No	Yes	10th	Patent graft	26	S	P.M.: patent graft. Aortography: coronary sinus graft patent and venous pathways of the heart
19	40	Basilic	3	4	1	No	Yes	12th and 28th	Not satis.	28	S	P.M.: patent graft. Two attempts at aortography unsuccessful
20	36	Ext. jug.	3.5	7	1	Yes	Yes	10th	Patent graft	11	CE	P.M.: patent graft. Edematous brain. Aortography: coronary sinus gft. patent and venous pathways of the heart
21	37	Ext. jug.	3.4	6	I–II	Yes	Yes	—	—	6	GH	P.M.: patent graft. Leak from coronary sinus site of anastomosis, hemothorax
22	32	Ext. jug.	3	6	I–II	No	Yes	21st	Not satis.	22	S	P.M.: patent graft. Coronary sinus thrombosed; graft not visualized on aortography
23	41	Ext. jug.	4	7	I–II	Yes	Yes	—	—	5	S	P.M.: patent graft, fibrinous pericarditis, localized, small area of subepicardial hemorrhage

TABLE I—(*continued*)

TABLE I—(*continued*)

Dog No.	Wt. lb.	Free Auto Vein	Length of Graft	Dia. of Graft	Stage of Operation	Post-operative Beck Murmur	Post-operative Digitalis	Post-operative Day Aortography	Result of Aortography	Duration of Graft (days)	Cause of Death	Remarks
24	32	Ext. jug.	3	7	I–II	Yes	Yes	21st	Patent graft	68	—	Aortography: patent graft and venous pathways of the heart; living
25	35	Ext. jug.	3·5	6	I–II	No	Yes	21st	Patent graft	62	—	Aortography: patent graft and venous pathways of the heart; living
26	40	Ext. jug.	3	8	I–II	Yes	Yes	—	—	39	—	Exploratory thorocotomy: patent graft with palpable thrill; living
27	45	Ext. jug.	3·3	8	I–II	Yes	Yes	—	—	28	—	Exploratory thorocotomy: patent graft with palpable thrill; 24 days P.O.; living
28	38	Ext. jug.	3	7	I–II	Yes	Yes	—	—	18	—	Living
29	34·5	Ext. jug.	3	7	I–II	Yes	Yes	—	—	12	—	Living
30	33	Ext. jug.	3	7	I–II	Yes	Yes	—	—	11	—	Living

P.M.= Postmortem.
I and II= Those animals on whom Stage I was done followed by a three week waiting period and then Stage II.
I–II= Those animals on whom Stages I and II were accomplished during the same operation.
S= Sacrificed. GH= Gross hemorrhage. CE= Cerebral edema.

FIG. 3. Animal B2 20. Contrast medium is visualized passing through the pulmonary circulation, the left atrium (*a*), left ventricle (*b*), and thoracic aorta (*c*).

In the 9 dogs selected for retrograde aortography, 4 had typical postoperative bruits which persisted, while 5 did not. Excellent aortograms were obtained in 7 of the 9 animals examined. The results in 2 were unsatisfactory because of technical difficulty. Two died as a direct result of aortography; 1 from cerebral edema, and the other from rupture and gross hemorrhage from the graft. The animal that died from the ruptured graft was only four days postoperative. The suture line at the site of coronary sinus anastomosis had not completely grown together, and it appeared that the added pressure from the injection mass weakened the line of anastomosis. The animal that died from cerebral edema had a convulsive episode at the time of injection of urokon. The right common carotid artery was not occluded at the time of

FIG. 4. Animal B2 12. Retrograde carotid aortogram. Thoracic aorta, graft, and coronary sinus are shown.

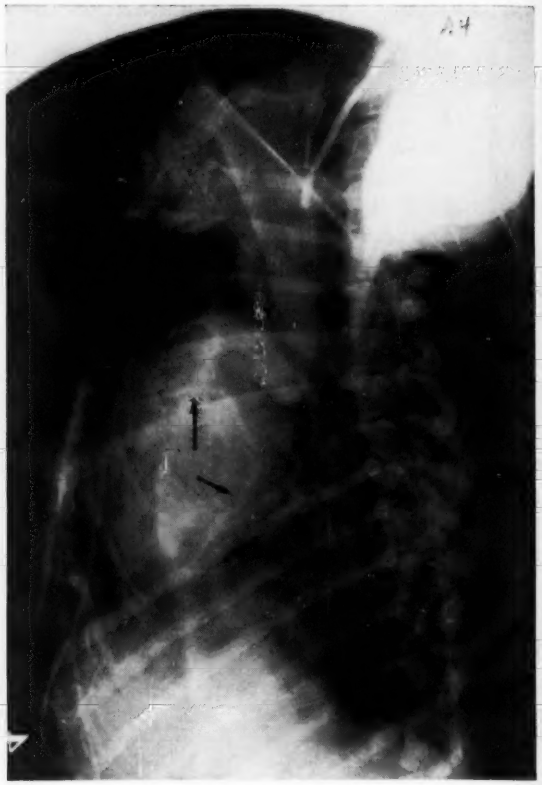


FIG. 5. Animal B2 12. Marginal veins well shown (arrows).

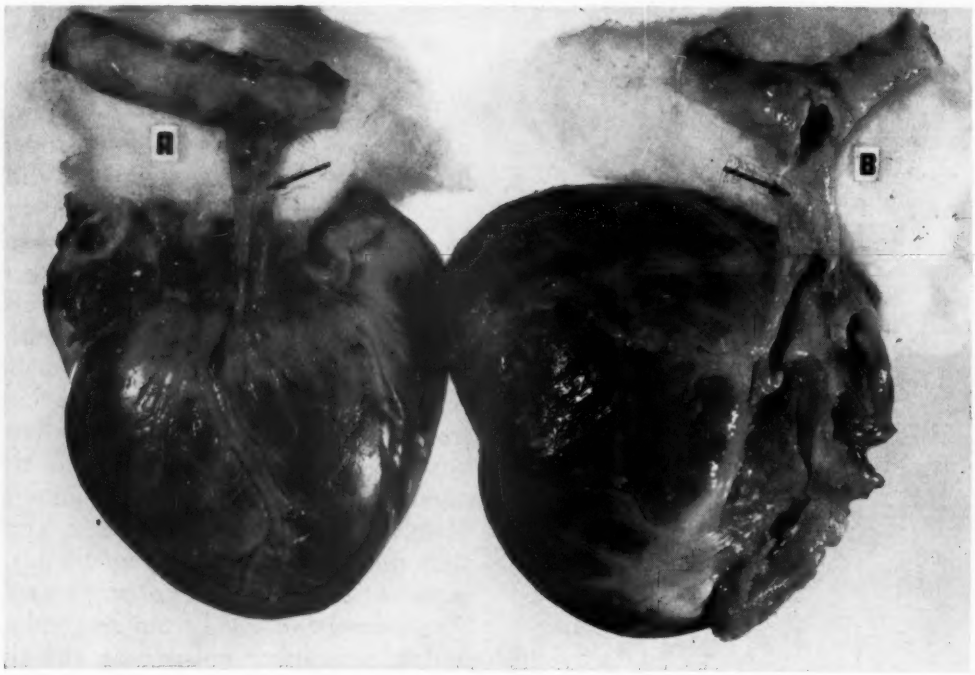


FIG. 6. Postmortem specimens. Animal B2 20 marked *A*. Animal B2 12 marked *B*. Aortic to coronary sinus grafts indicated by arrows; patency of grafts and sinuses demonstrated.

injection, and as a result a large volume of radiopaque material passed into the vascular system of the brain. Both animals died approximately twenty-four hours after the injection study.

The coronary sinus graft and venous pathways of the heart were well visualized in 6 of the 7 animals. The aorta and its major branches were well visualized in the other; however, the coronary sinus graft or venous pathways of the heart were not seen. This animal developed no postoperative bruit, and after completion of the original operation no palpable thrill was present in the graft. There was difficulty in identifying and isolating the coronary sinus in this animal. On postmortem examination the graft was patent but the coronary sinus had thrombosed.

Postmortem examination of the animals that died or were sacrificed showed 100 per cent patency of the vein grafts without evidence of thrombus formation. In 1 of the animals* the coronary sinus had thrombosed; however, the graft remained patent and free of thrombus. The animals that died from congestive heart failure showed gross evidence of pulmonary and myocardial congestion, and 3 in this group also had developed pleural effusion.

DISCUSSION

To our knowledge this is the first time retrograde carotid aortography has been successfully used to demonstrate the patency of coronary sinus graft and venous pathways of the heart in the living animal. In our opinion aortography in these cases is an innocuous method of determining patency without having to subject a patient to exploratory thoracotomy. Certain precautions, however, must be taken: (1) One should wait three weeks postoperatively before aortography is attempted to insure good healing at the lines of anastomosis of the graft. (2) One should make certain that the right and left common carotid arteries are completely occluded at the time of injection of the contrast medium to prevent cerebral edema.

From our study, apparently full digitalization immediately postoperatively protects the animals from developing congestive heart failure. The size of the graft (diameter of arteriovenous shunt) appears to be of little consequence once the animals are placed on daily doses of digitalis.

Rupture of the veins and capillaries of the heart from the full force of the aortic pressure by partially ligating the coronary sinus ostium during the first stage of the operation has not occurred during our studies. With the use of digitalis postoperatively the changes described[5] as intramuscular hemorrhage within the myocardium from rupture of the veins and capillaries within the heart appear to be congestive changes. Myocardial congestion was prevented in our animals that had Stages I and II performed during the same operation. The prevention of thrombus formation[5] by waiting three weeks before the second stage of the Beck operation is done can be accomplished through meticulous suturing of the graft at the time of the anastomosis. The venous pathways of the heart, in our experience, appear to be adequate to insure free flow of arterialized blood without thrombus formation through stasis of blood in the venous system of the heart. In our opinion, the second stage of the Beck operation can be safely eliminated on the basis of our experimental results.

SUMMARY

1. Retrograde carotid aortography has been described as an additional clinical aid in determining patency of coronary sinus grafts in the living experimental dog.

2. Use of digitalis postoperatively to prevent congestive heart failure has been described and discussed.

3. The elimination of the second stage of the Beck operation has also been discussed.

Aran S. Johnson, M.D.
816 David Whitney Bldg.
Detroit 26, Michigan

* See Table 1, animal 22.

REFERENCES

1. Beck, C. S., Stanton, E., Batiuchok, W., and Leiter, E. Revascularization of heart by graft of systemic artery into coronary sinus. *J.A.M.A.*, 1948, *137*, 436–442.
2. Beck, C. S. Revascularization of heart. *Ann. Surg.*, 1948, *128*, 854–864.
3. Beck, C. S. Revascularization of heart. *Surgery*, 1949, *26*, 82–88.
4. Beck, C. S. Operation for coronary artery disease. *Postgrad. Med.*, 1953, *14*, 95–100.
5. Hahn, R. S., and Beck, C. S. Revascularization of heart; study of mortality and infarcts following multiple coronary artery ligation. *Circulation*, 1952, *5*, 801–809.
6. Hahn, R. S., Kim, M., and Beck, C. S. Revascularization of heart. Observations on circulation following arterialization of coronary sinus. *Am. Heart J.*, 1952, *44*, 772–780.
7. McAllister, F. F., Leighninger, D., and Beck, C. S. Revascularization of heart by vein graft from aorta to coronary sinus. *Ann. Surg.*, 1951, *133*, 153–165.

Vol. 72, No. 4

A PNEUMATIC REMOTE CONTROL PRECISION INJECTOR FOR INTERSTITIAL AND INTRACAVITARY INJECTION OF RADIOACTIVE COLLOIDAL GOLD

By S. TAPLITS, M.D.
Radioisotope Laboratory, Jewish Hospital
CINCINNATI, OHIO

A METHOD for interstitial and intracavitary injection of radioactive gold has been devised wherein the injection is performed under complete control of the operator by a remote control mechanism which is simple and semi-automatic. The factor of distance is utilized in preference to heavy shielding which makes for awkward and unwieldy handling of syringes containing radioactive gold of high activity.

The mechanism consists of a pneumatic damper motor to which is attached a 5 cc. No. 5YLC-B.D. syringe with finger ring. A gradual pressure switch, which is a precision controlled instrument, is connected by pressure tubing to the pneumatic motor and to the reducing valve of an air pressure tank. Thus, by turning the dial of the gradual pressure switch, the air flow can be regulated precisely to permit the plunger of the syringe to aspirate or inject any volume desired. A Luer-Lok B.D. automatic double valve is attached to the syringe which permits the automatic withdrawal of the radioactive gold from the lead pig and automatic injection into the tissue.

The operator can manipulate the syringe from any distance from the active source by a simple turn of the knob and also can measure any volume of radioactive gold with precision. The controls may be so finely adjusted that the volume of liquid injected can be regulated to a fraction of a cubic centimeter.

In interstitial injections for prostatic carcinoma, pressure control is particularly important. The amount of air pressure applied to the syringe plunger through the damper motor can be varied between 15 and 30 pounds per square inch evenly and with full control.

By means of a Luer-Lok adapter 10 ft. of No. PE 100 polyethylene tubing, which will fit a 20 gauge needle, is attached to the syringe. The volume contained in the entire 10 ft. of this tubing is 1.7 cc. Prior to attachment to the syringe, the tubing is sterilized in zephiran solution for twenty-four hours, sheathed in sterile lead foil 0.3 to 0.6 mm. in thickness and threaded into an equal length of sterile rubber tubing. This prepared sterile tubing, through which the gold flows under pressure, is handed to the surgeon who grasps the attached needle in a needle holder and is ready to proceed with the injection of the tumor mass. The isotopist, who is directly behind the surgeon and who holds the precision control panel in his hand, is directed by the surgeon to inject the prescribed volume of gold. The isotopist turns the dial and injects the solution at any pressure or speed that is indicated, meanwhile observing the operative field for possible leakage about the needle or from the tissue itself.

This technique was followed in the injection of an intrathoracic malignant tumor weighing 270 gm. with 122 mc. Au^{198} contained in a volume of 34 cc. given in increments of 2 cc. per injection. The technique worked smoothly, with no spillage or leakage and under the complete control of the isotopist and surgeon.

Description of the Apparatus

B.D. Luer-Lok syringe with finger ring No. 5YLC

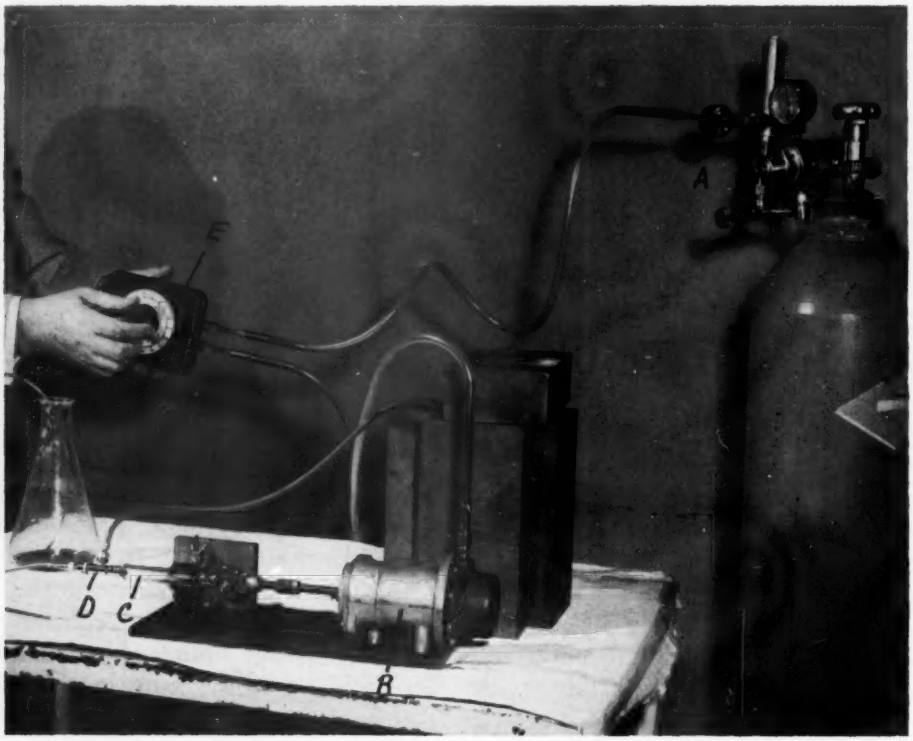


FIG. 1. Syringe empties when switch is opened. *A*, test gauge; *B*, damper motor; *C*, B.D. Luer-Lok syringe, 5 cc. No. 5YLC; *D*, B.D. automatic double valve; *E*, gradual pressure switch.

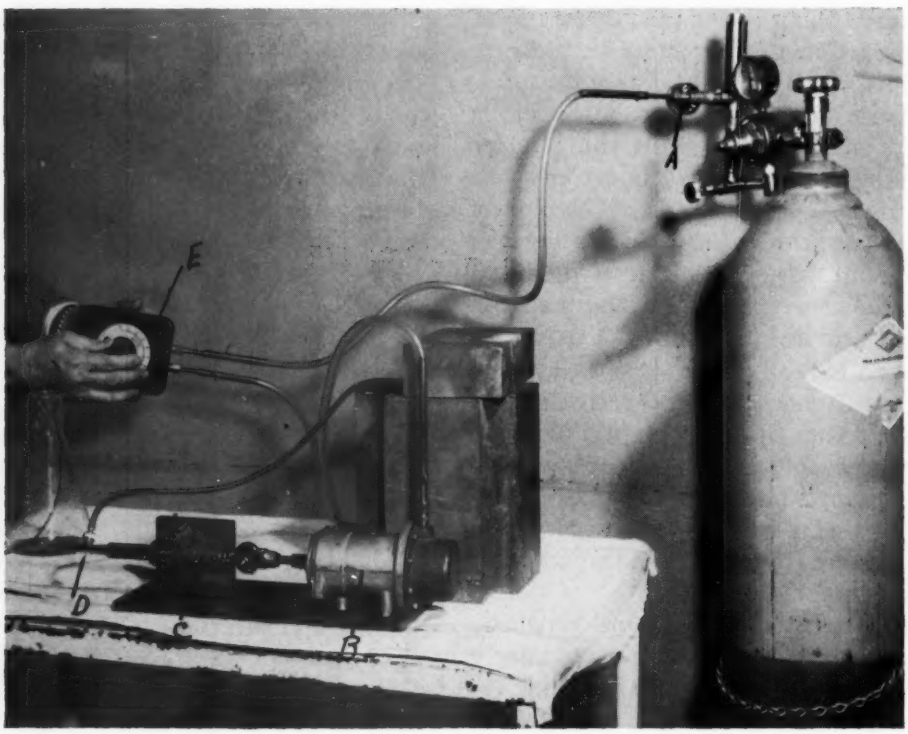


FIG. 2. Syringe automatically fills when switch is closed. *A*, test gauge; *B*, damper motor; *C*, B.D. Luer-Lok syringe, 5 cc. No. 5YLC; *D*, B.D. automatic double valve; *E*, gradual pressure switch.

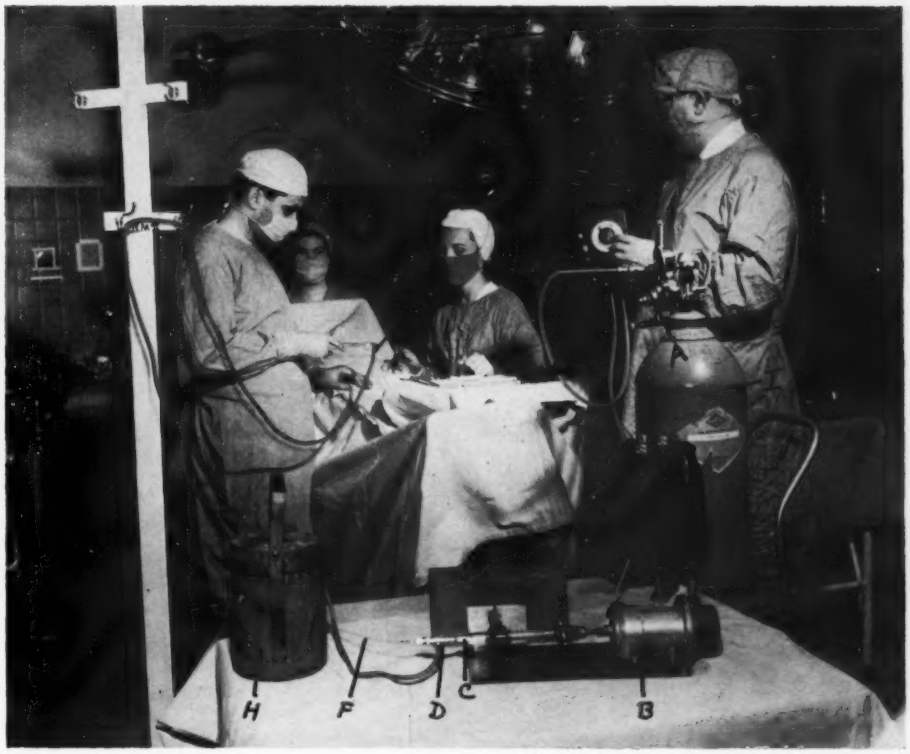


Fig. 3. Operating room preparatory to interstitial injection of radioactive gold by remote control. *A*, test gauge; *B*, damper motor; *C*, B.D. 5 cc. No. 5YLC syringe; *D*, B.D. automatic double valve; *E*, gradual pressure switch; *F*, polyethylene tubing No. 11; *G*, sterile sheathed polyethylene tubing with needle attached; *H*, lead pig container for radioactive gold; *I*, tank of compressed air.

B.D. automatic double valve No. 470V
Polyethylene tubing PE 100
No. 2 damper motor type "W" Bracket 5–10 lb. spring
S-222 gradual pressure switch
Test gauge SP-1316
(Johnson Service Co., 1905 Dunlop St., Cincinnati, Ohio)
Air pressure tank
Reducing valve

SUMMARY

A description is given of a remote control injector which has been devised for the interstitial and intracavitary injection of radioactive colloidal gold solution.

S. Taplits, M.D.
Jewish Hospital
Cincinnati 29, Ohio

Acknowledgment is made to Dr. Archie Fine of the X-Ray Department of the Jewish Hospital, Cincinnati, Ohio, for his generous cooperation and to Dr. Robert Gallagher of the U. S. Public Health Service for his aid in monitoring the apparatus; also to Mr. Brinkman of the Johnson Service Co. for his efficient assembly of equipment.

A TECHNIQUE FOR EVALUATING THE EFFECTIVENESS OF LOCALIZATION OF RADIOACTIVE COLLOIDAL GOLD-198 AFTER DIRECT INJECTION INTO TUMORS*

By JOHN U. HIDALGO, M.S.,† EDGAR BURNS, M.D.,‡ *and* ROBERT T. NIESET, PH.D.*

With the technical assistance of RICHARD FLECK

NEW ORLEANS, LOUISIANA

THE primary objective of the direct injection[1] of radioactive colloidal gold (Au^{198}) is localization of the radioactive material in the tumor or metastatic lesions. With this technique there are no other intended areas to be subjected to irradiation. The effectiveness of this method has been demonstrated by Hahn and Carothers[2] and others.[3,4] However, the possibility of variation from one patient to the next, depending upon the size and vascularity of the tumor, has indicated a need for a technique by which the effectiveness of the colloidal localization could be routinely checked.

Various Geiger-Müller counter arrangements were tried with different tube shields and absorbers. It was found that a great amount of shielding was necessary to reduce counting rates to a level at which they could be accurately measured. The weight and bulkiness of this shielding made this approach unsatisfactory. Moreover, the results obtained did not definitively locate the boundaries of the retention site of the radioactive gold. Even with massive shielding, all attempts to evaluate liver and spleen uptakes failed because of the high background counting rates produced by the radiation from the prostatic area.

Müller[3] and Müller and Held[4] demonstrated the practicability of in vivo radioautographic techniques with injections of relatively large doses of radioactive isotopes. Based upon this method, a technique has been developed at this institution for the routine determination of distribution of radioactive gold in the body. Basically, it is a combination of radioautographic and roentgenographic techniques involving the following procedure:

1. A large roentgenographic cassette is oriented beneath the supine patient so that the area covered includes the pelvic girdle and as much of the thoracic cage as possible. If the procedure is performed immediately after injection, the cassette is left thus for four minutes. If done later, the exposure time is adjusted for the decay of the radioactive gold. This exposure time (4 minutes) gives an adequate radioautographic image on the film for the patient dosages of about 100 mc.

2. At some time during exposure, a portable roentgenographic unit is wheeled into position over the patient and a light exposure made. The unit is set to deliver 5 kv. roentgen rays for 0.5 second at about 14 milliamperes. This completes the technique for this film except for processing and evaluation. However, at this time, a second cassette is exposed in identical fashion except that the roentgen-ray exposure time is cut to 0.2 second. Both films are then routinely processed.

The two roentgenographic exposures are so designed as to give two different intensity roentgenographic images. The longer exposure yields a rather good pattern of the pelvic girdle and yet the exposure is not such that it obliterates the radioautographic image of the radioactive gold. The arrangement is used to evaluate the gross distribution pattern of the radioisotope after injection.

Figure 1 is such an exposure made twenty-four hours after injection of 112

* From the Biophysics Laboratory† Tulane University School of Medicine and the Departments of Urology‡, Ochsner Clinic and Tulane University School of Medicine, New Orleans, Louisiana.

Fig. 1

mc. of Au^{198} into a prostatic tumor showing that at least the greatest portion of the radioisotope is well confined to the site of injection. Figure 2 is the same type exposure; that is, one made twenty-five hours after injection of 126 mc. of Au^{198} into a bladder tumor. Again, the characteristic distribution pattern is present.

Fig. 2

The short exposure film presents the same picture except that the bone structure is faint. These are made light so that image densities can be measured. On all of these films density measurements are made over the injection site, liver, spleen and a point on the film midway between the liver and spleen readings. These measurements have been made on films from 11 patients.

With the midline value at the height of the liver and spleen as a "background density," these densitometer data are summarized in Table 1.

Table I

Position	Light Absorption (per cent)	Image Density (arbitrary units)
Tumor site	87.0	0.590
Liver	33.2	0.014
Spleen	11.7	0.007

The values are averaged from measurements on films from the various patients. Considering that the aperture of the densitometer is small, these values are only interpretable on a "unit mass" type basis; that is, on the basis of radioisotope concentration per unit volume of the tissue under consideration.

On this basis, the data can be interpreted to mean that the unit concentration in the tumor is about 42 times that of the unit concentration in the liver. Also it can be said that the liver unit concentration is about twice that of the spleen.

It can easily be demonstrated that there is no selective absorption of radioactive gold in the head or extremities. We have measured excretion levels for one week after injections in all of these patients and in every one the amount excreted was less than 1.5 per cent of the administered dose. It may then be concluded that this film

technique effectively covers the area in which the gold is confined.

These films may also be surveyed with a densitometer if radiation isodose zones are desired. In other words, anything one would like to have done with a counter can now be done with the densitometer. However, the distribution of the radioactive material is the desired information in a counter scan and this information is presented directly by the film.

Examination of the blackened area shows that this area is not one of uniform density but rather one in which the degree of opacity of the spot increases to a maximum in the approximate center. This indicates that the source is not a diffuse one but rather one which is well confined to the area of the prostate or bladder. It is obviously not an accumulation in the urine since these patients are all catheterized and also the excretion data show such little loss by this means.

SUMMARY

A new procedure involving radioautographic and roentgenographic techniques has been described which provides a ready means of routine checking of the effectiveness of the direct injection of radioactive colloidal gold. The distribution data are based upon interpretation of the resulting films, and as so presented, afford rapid evaluation of the gross distribution picture and also comparative data on unit concentration in tumor, liver and spleen.

The technique as described has been developed around the direct injection of Au^{198} into the prostate; however, there are no apparent limitations of the method. It would seem that this technique could be used in almost any procedure of a general type involving therapeutic dosage levels of radioactive materials in specific sites.

John U. Hidalgo, M.S.
Biophysics Laboratory
Tulane University
New Orleans 18, Louisiana

REFERENCES

1. Flocks, R. H., Kerr, H. D., Elkins, H. B., and Culp, D. Treatment of carcinoma of prostate by interstitial radiation with radio-active gold (Au198); preliminary report. *J. Urol.*, 1952, *68*, 510–522.
2. Hahn, P. F., and Carothers, E. L. Use of radioactive colloidal metallic gold in treatment of malignancies. *Nucleonics*, 1950, No. 1, *6*, 54–62.
3. Müller, J. H. Beiträge zur medizinisch-therapeutischen Verwendung der künstlichen Radioaktivität. *Strahlentherapie*, 1951, *85*, 87–125.
4. Müller, J. H., and Held, E. Über die direkte Infiltration von malignen Tumoren und neoplastischen Ausbreitungszonen mit kolloidalem Radiogold Au^{198} sub operationem. *Gynaecologia*, 1951, *131*, 385–388.

VOL. 72, No. 4

THE USE OF RADIOACTIVE ISOTOPES FOR DIAGNOSTIC RADIOLOGY*

By G. E. DENNIS, *and* H. A. DELUCA
LONDON, ONTARIO, CANADA

ALTHOUGH radioactive isotopes have found various applications in diagnosis and therapy, their use in medical radiography has not been extensively investigated. Certain isotopes, such as cobalt-60 and iridium-192, have been widely used in industrial radiography. In the latter field, isotopes offer greater portability and eliminate the need for the electrical power supply required by roentgen-ray equipment. The advantages of a similar radiographic unit which could be taken to the patient, especially under emergency conditions, is obvious.

Shortly after the discovery of radium, attempts were made to use its gamma radiation for medical radiography. More recently (1948), Spangenberg[8] reported on the use of radioactive isotopes for this purpose; his study was confined to dental applications, the source being placed for experimental purposes inside the oral cavity of a skull. The isotopes investigated were primarily those whose decay is by K-electron capture, use being made of the resultant roentgen radiation. No information is given concerning the physical size, activity of the sources, nor of exposure times. A reproduction of a radiograph of teeth, taken with cerium-139, is of encouraging quality.

In 1950 Mayneord[4] suggested that by placing low energy gamma-ray sources inside body cavities, useful radiographs might be obtained. In 1952, the same worker[5,6] reported on the use of thulium-170. Since his source was of low activity, lengthy exposures were required. The published radiographs of dried skulls possess fair definition and contrast.

Recently West[11] has suggested americium-241, as a source for medical radiography. A radiograph of a femur taken with this isotope is included in his report.

In the present communication, the radiographic properties of thulium-170 and cerium-144 are presented. Thulium-170 emits a single gamma ray of 0.084 mev. Cerium-144 is the source of a number of gamma rays, the maximum energy of which is 0.134 mev. However, a product of its decay, praseodymium-144, gives rise to gamma rays of 0.695, 1.48 and 2.185 mev. respectively.[1] There is evidence suggesting that the relative intensities of the latter rays are not very great.

It might be pointed out here that cerium-144 is a fission product whereas thulium-170 is produced in the pile by neutron bombardment of nonradioactive thulium.

EXPERIMENTAL PROCEDURE

Thulium-170. Approximately 5 curies of thulium-170 was enclosed in a lucite container with 3/16 inch walls in order to eliminate beta particles. This was loaded in a camera with an adjustable collimator and a manually operated shutter. The area of source presented to the film was in the form of a circle of 3/8 inch diameter. Since only 10 per cent[7] to 24 per cent[3] of thulium-170 disintegrations yield gamma rays, the effective activity in terms of gamma radiation of this source was of the order of 1 curie.

The material irradiated weighed 170 milligrams; 48 per cent was thulium oxide, the remainder being divided between the oxides of the rare earths and other metals. Absorption measurements indicated that there was no appreciable contribution by these impurities to the gamma-ray spectrum of the source.

Cerium-144. Two cerium sources were used in the experiments to be described. The first source consisted of 150 millicuries

* From the Radioisotope Unit, Department of Biochemistry, University of Western Ontario, London, Ontario, Canada.

FIG. 1. Hand of live subject taken with 5 curies thulium-170 using Hi-speed screens. Source-film distance: 11 inches. Exposure time: 2 minutes.

which had been precipitated from solution with ferrous hydroxide and collected on filter paper. After ashing the filter paper, the cerium-containing precipitate was placed in a lucite container having 1/2 inch walls. For the second source, 15 curies of cerium-144 was obtained in the form of cerium chloride dissolved in 700 cc. of dilute hydrochloric acid. This was evaporated to dryness in a teflon container. The resulting source was in the form of a cylinder 3/8 inch in diameter and 3/16 inch in length. The loaded container was mounted in a camera employing a movable source rather than a shutter.

QUALITY OF RADIOGRAPHS

Various radiographs were taken using cadavers and live subjects with cerium-144 and thulium-170.

In Figure 1 is shown the hand of a live subject taken with 5 curies of thulium-170. In Figure 2 is shown a similar radiograph of a cadaver hand, the source-film distance and exposure times having been increased. A cadaver elbow taken under similar conditions is reproduced in Figure 3.

Radiographs of thicker body parts were attempted. With increasing thickness there was a loss of definition and contrast. Radiographs of the arm, for example, were of sufficient clarity to permit the diagnosis of a fracture but those of a thicker section, such as a shoulder joint, were so lacking in definition and contrast that they would be of no diagnostic value. Since part of this loss of detail was undoubtedly due to scattering, a stationary grid was used for some exposures. This yielded a slight improvement in quality but it was not sufficient to be of practical value. Admittedly the grid employed was intended for use with radiation of lower energy. A grid designed for higher energies presumably would yield further improvement.

A series of radiographs similar to those indicated above was taken with the cerium-144. Three of these are shown in Figures 4, 5 and 6. There is very little difference in detail or contrast in these radiographs

FIG. 2. Hand of cadaver taken with 5 curies of thulium-170 using no-screen film. Source-film distance: 22 inches. Exposure time: 1 hour.

compared with those taken with the thulium source.

The problem of shielding against beta rays and the difficulty of adequately sealing the source prevented the testing of the cerium and thulium as intraoral sources for dental radiography in living subjects. With the available sources, extraoral use was not practical as it was found impossible to immobilize a live subject for sufficiently long periods. The radiographs that were attempted were so underexposed that an adequate assessment of the value of these sources in this regard could not be made. However, with a skull in which wax was used to simulate tissue, acceptable radiographs were obtained. A typical one is shown in Figure 7.

The radiographs described above with one exception were taken with no-screen film. The use of the usual intensifying screens decreased the exposure times by a factor of approximately ten, but this was accompanied by a loss of definition. Thulium-170 proved to be a somewhat more effective source with these screens than cerium-144. Radiographs were likewise taken using lead screens 0.005 inch thick. Placed on both sides of the film these resulted in decreased definition and contrast but there was no corresponding decrease in exposure time. Placed behind the film only, lead screens increased the densities of all portions of the radiographs with a lessening of image definition. West[11] reports the use of 0.0015 inch lead front screens and 0.005 inch lead back screens for industrial radiography with thulium-170.

Fig. 4. Hand of cadaver taken with 150 millicuries of cerium-144 using no-screen film. Source-film distance: 24 inches. Exposure time: 17 hours.

Fig. 3. Elbow of cadaver taken with 5 curies thulium-170 using no-screen film. Source film distance: 22 inches. Exposure time: 1 hour.

CHEMICAL INTENSIFIERS

An attempt was made to decrease exposure times by the use of intensifiers. Kodak intensifier In-6[2] permitted a decrease in exposure by a factor of four. This technique gave a marked increase in contrast but added greatly to the processing time. The resultant radiographs were grainy and of a brownish color. Results were difficult to duplicate.

FIG. 5. Hand of cadaver taken with 15 curies of cerium-144 using no-screen film. Source film distance: 21 inches. Exposure time: ½ hour.

DISCUSSION

The radiograph of the cadaver elbow shown in Figure 3 was exposed at 21 inches for one hour using 5 curies of thulium-170. In order to convert to the normal roentgen-ray distance of 30 inches and to decrease exposure time to one second, a 35 kilocurie source would be required for equivalent results. If, using no-screen film, one were willing to accept an exposure time of twenty seconds and two-thirds the usual source-film distance, then a 1 kilocurie source would be sufficient. The use of fluorescent intensifying screens and appropriate film would permit further reduction in either exposure time or source size but at the expense of definition. Thus, in the example given above, this would decrease exposure time from twenty to two seconds or source size from 1 to 0.1 kilocurie.

Compared to the 5 curies of thulium-170, the high curie cerium-144 source reduced exposure times by a factor of two. This is not what is to be expected when one considers that per disintegration cerium-144 yields a multiplicity of gamma rays while thulium-170 emits only 0.1 to 0.24 gamma ray. This low radiographic efficiency of the gamma rays from cerium-144 results in the need for source sizes of the same order of magnitude as those calculated above for thulium-170.

Mayneord[6] estimates that 100 kilocuries of an isotope emitting 1 low energy gamma ray per disintegration would be required to produce the maximum radiation intensity used for radiography (300 roentgens per minute at 20 inches). This calculation is supported by our experimental results; however, as is shown above, the source size needed in selected applications could be reduced. As already indicated a portable unit for diagnosis of limb fractures (and presumably location of metallic fragments) could be constructed with 0.1 to 1 kilocurie of cerium-144 or thulium-170.

Isotopes, such as cerium-144, which can be obtained from the separation of fission products, have a potential advantage in radiography over pile-produced isotopes of

FIG. 6. Elbow of cadaver taken with 15 curies of cerium-144, using no-screen film. Source-film distance: 21 inches. Exposure time: ½ hour.

the kind represented by thulium-170. In the latter instance, the radioactive isotope is diluted by a relatively large amount of the inactive element; in the former type, it is theoretically possible to prepare a source in which all atoms are radioactive. Thus, using separated isotopes, kilocurie sources might be prepared whose physical dimensions are similar to the focal spot in conventional roentgen-ray equipment. On the other hand, certain radioisotopes produced by neutron bombardment, such as thulium-170, have the advantage of reactivation in the pile when their activity has fallen to low levels.

West [11] has suggested the use of americium-241 for diagnostic radiology. While this isotope has a gamma ray (0.059 mev.) in the energy range currently employed in roentgen-ray technique, the low specific activity (3.2 curies/gram) would result in sources of objectionably large physical dimensions.

It is apparent from the foregoing discussion that the use of radioactive isotopes for medical radiography depends to a large extent on the availability of kilocurie sources of suitable isotopes. It is quite probable that kilocurie amounts of radioisotopes in general will become more available in the future.[9] On the other hand, no isotope tested to date by the several investigators is ideal in all respects for the purpose suggested in this report.

Fig. 7. Dental radiograph of skull taken with 150 millicuries of cerium using no-screen film. Source-film distance: 12 inches. Exposure time: 1 hour.

H. A. DeLuca, M.D.
346 South St.
London, Ont., Canada

The authors wish to thank Dr. R. J. Rossiter, Head of the Department of Biochemistry for his guidance during this project. They are also indebted to the following: Dr. W. B. Lewis and Dr. A. J. Cipriani of Atomic Energy of Canada for their helpful criticism and to their company for making available the radioactive sources; Dr. D. L. Bartelink, Head the Department of Radiology, for his assistance in preparing the manuscript; Isotope Products, Ltd., Oakville, Ontario and in particular Dr. P. J. Stewart of this company, for technical assistance. Finally, thanks are due to John Labatt, Ltd., London, Ontario whose grant made this project possible.

REFERENCES

1. Alburger, D. E., and Kraushaar, J. Decay scheme and angular correlation of Pr^{144}. *Phys. Rev.*, 1952, *86*, 633.
2. Corney, G. M., and Splettstosser, H. R. Intensification of x-ray diffraction films to increase speed. *Rev. Scient. Instruments*, 1952, *23*, 98–99.
3. Graham, R. L., Wolfson, J. L., and Bell, R. E. Disintegration of Tm-170. *Canad. J. Physics*, 1952, *30*, 459–475.
4. Mayneord, W. V. Some applications of nuclear physics to medicine. *Brit. J. Radiol.*, 1950, Suppl. no. 2, *44*, 191.
5. Mayneord, W. V. Radiography of human body with radioactive isotopes. *Lancet*, 1952, *1*, 276–278.
6. Mayneord, W. V. Radiography of human body with radioactive isotopes. *Brit. J. Radiol.*, 1952, *25*, 517–525.
7. National Bureau of Standards, U. S. Dept. of Comm., Nuclear Data, N.B.S. Circular 499 and Suppl. 1, 2 and 3.
8. Spangenberg, H. D. Production of roentgenograms by means of x-ray radiation from artificially radioactive isotopes. Ohio State Univ. Eng. Experimental Station News, 1948, *20*, No. 5.
9. Stanford Research Inst. Industrial uses of radioactive fission products. 1951.
10. Sullivan, W. H. Trilinear chart of nuclear species. John Wiley & Sons, Inc., 1949.
11. West, R. Low-energy gamma-ray sources. *Nucleonics*, 1953, *11*, No. 2, 20–23.

COMPARISON OF RADIOTHERAPY ABROAD AND IN THE UNITED STATES*

By ROBERT E. FRICKE, M.D.
Section of Therapeutic Radiology, Mayo Clinic
ROCHESTER, MINNESOTA

IN EVALUATING concepts and techniques of therapeutic radiology anywhere, there is no substitute for actual observation of the daily work in other clinics. Articles in medical journals are available to everyone, but these usually stress the most unusual problems or the most successful therapeutic efforts. A radiologist in this country can easily visit and profit from observation of work at other centers, and he knows quite well the ideas of men engaged in therapeutic radiology in the United States. On the other hand, trips abroad are time-consuming and expensive.

During the summer of 1951, I had the opportunity of spending a few weeks at foreign clinics. This proved to be an invaluable experience. Foreign radiologists in every center I visited were most courteous, patient, and helpful, and I was much impressed by their conscientious work and enthusiasm.

TRAINING OF RADIOLOGISTS

The basic training in radiology abroad differs from that in the United States. In most European countries, roentgen diagnosis and radiation therapy are separate specialities. In England, a physician selecting radiation therapy spends two years of training in therapy and one year in diagnosis, pathology, and elective subjects, while one interested in diagnosis spends two years in diagnosis and only one in therapy and related subjects. An examination is then taken, and after two or three years of practice, the specialist can register as such.

In Denmark, six years of postgraduate training are necessary; a man specializing in therapy spends three years in therapy, one year in diagnosis and two years in general surgery and medicine. For diagnosis, the time spent is reversed.

In Sweden, nine years of postgraduate work are required, divided as follows: three years devoted to surgery, three years to obstetrics and gynecology, and three years to radiotherapy. There are only a few men so trained and they direct the work at Radiumhemmet, the radiotherapeutic teaching part of the Karolinska Medico-Kirurgiska Institutet in Stockholm. Radiumhemmet serves as a postgraduate center for all of Sweden; most Swedish radiologists spend six months to a year in training there.

My own personal opinion is that radiation therapy abroad is somewhat more advanced than in this country, and if so, it is most probably owing to the separation of diagnosis and therapy into distinct specialities, permitting further development of radiotherapy.

WORK IN ENGLAND

Lack of time precluded trips to many of the foremost English clinics and hospitals; however, four in London and one in Manchester were visited. The work at the Royal Cancer Hospital in London impressed me as outstanding, both in the excellence of the staff and in the variety of equipment. This one hundred year old hospital has 140 beds for patients with malignant disease; 15 gm. of radium are in use, 10 gm. of this total in a bomb. Dr. Lederman has charge of the radium therapy. Fifteen roentgen therapy tubes are employed, varying from contact therapy to a 2,000,000 volt apparatus. Professor Mayneord has fifteen physicists working with him on many research projects in radiation physics. Much work is done with radioactive isotopes; the radioactive wastes are buried under 25 feet

* Read at the Thirty-fifth Annual Meeting, American Radium Society, St. Louis, Mo., April 20–22, 1953.

of cement, thirty-five miles outside of London.

Hammersmith Hospital in London is a general hospital containing 800 beds, 60 of these for patients requiring radiotherapy. Postgraduate training is given there. Dr. Constance Wood, who did much of the original work with the radium bomb, is in charge of radiotherapy.

The Marie Curie Hospital in London is a small hospital situated in a beautiful residential section. The original hospital was destroyed by bombs during the war; private homes nearby have been purchased, containing about 50 beds. Dr. Gilmour has charge of radium therapy and Dr. Riach of roentgen therapy. Only gynecologic conditions are handled. Work here began as a project to study the effects of radium therapy. The Stockholm technique of treatment is followed for pelvic cancer.

Middlesex Hospital in London is another large general teaching hospital, connected with London University, training undergraduate students in medicine and surgery. It has a capacity of 720 beds, 64 of these reserved for radiotherapy. About 150 patients having cancer of the cervix are treated annually; the French method of treatment is followed.

Manchester, a city of about 800,000 people, 190 miles north of London, contains the famous Holt Radium Institute, dating from 1905, and the Christie Hospital, added in 1932. Sixteen grams of radium, 10 of these in a bomb, are in use here, as well as six or seven roentgen tubes functioning at 250 kv., and one at 500 kv.; 6,000 new patients are seen annually, and 500 patients with cancer of the cervix are treated each year. Dr. Ralston Paterson is director of radiation and Dr. Todd is the radiotherapist. Mr. Meredith, who has lectured in this country on the Manchester system of treatment, is chief physicist. The physical aspects of radiation therapy have been worked out in great detail. The Paterson-Parker dosage tables are studied throughout the United States by practically all embryo radiologists. Dr. Paterson teaches students from all over the world, and his clinics are excellent. Much work is done with molds and casts; wax molds and later plaster casts are made of the head and neck or chest of patients with cancer in these areas; spent radon seeds are buried in these molds at the limits of the malignant growths, and roentgenograms are taken to show these boundaries. The intersection of treatment beams is determined by metal wires passed through the molds, and further roentgenograms are taken. The surface dose and tumor dose are determined in these studies.

RADIATION THERAPY IN FRANCE

The Curie Foundation in Paris is the acknowledged leader of radiation therapy in France and in the Southern European countries. The French philosophy of treatment is based on research work of the pioneer Regaud; since cancer cells appear to be more vulnerable during mitosis than at other periods, prolonged continuous treatment with small amounts of radium seems most likely to destroy cancer cells as they pass through their reproductive phase. This principle also applies to roentgen therapy; treatment is prolonged over many weeks. The work is conscientious and achieves good results; modifications of the French method are used in Southern Europe, and in many clinics in the United States.

CANCER TREATMENT IN SWITZERLAND

Discussion with a radiologist in Zurich, a friend who had trained with us in the United States, disclosed that concepts of cancer therapy were far from unified in Switzerland. Each of the cantons had its own ideas of treatment; some preferred surgery, some irradiation; most of them had their own supply of radium and roentgen equipment.

RADIATION THERAPY IN DENMARK

The outstanding radiation therapy center in Denmark is that of Dr. Jens Neilsen,

the Radium Center at Copenhagen. This serves one-half of Denmark, an area of about 2,000,000 people. There are two other radium centers in smaller cities. Dr. Neilsen is an excellent radiologist; he has traveled widely and is well known in the United States. The radium center has 125 beds and is used only for radiotherapy. A radon plant containing about 2 gm. of radium is in use, and another 1.5 gm. of radium is distributed in tubes and needles. Eleven high voltage roentgen-ray machines are in use. Pelvic cancer is treated by modifications of the Stockholm technique. Since the tracing of treated patients is efficient in as small a country as Denmark, results of treatment can be well evaluated.

RADIOLOGY IN SWEDEN

Radiumhemmet in Stockholm is as world famous as the Curie Foundation in Paris. It serves two-thirds of Sweden. Although radium therapy in Stockholm began in 1908 to 1910, the present Radiumhemmet was built in 1937. It contains about 35 beds. A large quantity of radium is in use, 12 gm. in all. Twelve roentgen therapy machines are utilized. About 380 patients with cancer of the cervix are treated annually. Radiumhemmet serves as a teaching center for the Caroline Institute. Although the radiologists in charge have had thorough surgical training, irradiation rather than surgery is relied on for early malignant lesions. The Stockholm technique utilizes stronger units of radium than the French, with heavy divided doses rather than continuous treatment, and employs heavy lead filtration around the radium. The follow-up of all treated patients is almost 100 per cent. The Stockholm technique is employed in most of Northern Europe, and in many English centers. The "packing method" of treating cancer of the uterine corpus, filling the uterine cavity with many tubes, was made widely known by Radiumhemmet.

RADIATION TREATMENT IN NORWAY

The Radium Hospital at Oslo, Norway, serves practically all of Norway; 5 gm. of radium are in use, 4 of them in a bomb, and six roentgen-ray tubes function at 170 kv. About 350 patients with cancer of the cervix are treated annually. The hospital has 144 beds; at the time of my visit the department of gynecology was being enlarged. The Stockholm technique of radiotherapy is followed.

IDEAS OF FUTURE PROGRESS

At several of the London centers, notably the Royal Cancer Hospital and Hammersmith Hospital, sources of higher intensity radiation for deep-seated tumors are being sought. At Hammersmith Hospital, Dr. Constance Wood, pioneer in much of the development of the radium bomb, was enthusiastic about the possibilities of the linear accelerator. This seemed to her preferable to the betatron, the cobalt bomb, or the Van de Graaff apparatus; a better depth dose could be obtained. She thought the linear accelerator might function at 10 mev. and produce 400 r per minute. At Manchester, Mr. Meredith also preferred a linear accelerator to the betatron, and thought that the cobalt bomb, furnishing gamma rays equivalent to 2 mev., would also prove valuable for treatment of deep-seated lesions.

The Curie Foundation and Radiumhemmet, as far as I could determine, did not seem as interested as the English centers in developing more penetrating radiation at this time.

COMMENT

A brief survey of radiotherapy at leading clinics abroad leads to certain conclusions. The impressions gathered by one person are of little importance; many members of this society who have studied conditions abroad may agree or disagree with my opinions.

All of us know that excellent radiation therapy is practiced at many locations in this country. We are equally aware that much substandard work is performed throughout the country. Radium therapy especially has not lived up to its potenti-

alities. Effective radium treatment is exacting, tedious and time consuming; many radiologists have deeded this form of treatment to specialists in other fields of medicine. Teaching of radium therapy has often been superficial. The American Board of Radiology and the American College of Radiology will doubtless correct these shortcomings in time.

Roentgen therapy in this country has achieved good results, but frequently radiologists, because of volume of work, cannot give proper time to individualize treatment and secure exact positioning and accurate direction of the treatment beam. Too much detail may be left to technicians; work may be speeded up by enlarging the portals, decreasing filter, and omitting much personal supervision.

Radiation therapy as practiced abroad surprised me by the precision and care exercised by the radiologists. It is true that I visited only outstanding clinics. In Britain, I had the impression of undue reliance on physics. Basic physics is essential in determining dosage, but exact dosage in so complex a medium as living human tissue cannot be entirely based on the slide rule and calculus. Experience—that is, careful observation of radiation effects in tissue—is also important; although until a radiologist acquires experience, basic dependence on formulas worked out by physicists furnishes the necessary safe limits of dosage.

My general conclusion is that in the major centers of radiotherapy abroad the work is superior to much of the work in this country. This, I believe, is owing to the separation of therapeutic and diagnostic radiology into distinct specialities, which has existed since the advent of radiology in most European countries. This has made postgraduate training in the treatment of cancer and allied diseases longer and more thorough, and produced better utilization of radium and roentgen rays. Several of our foremost radiologists in this country have urged that therapeutic radiology be a distinct specialty,[1,2] and this field is now enlarging with the use of several radioactive isotopes in therapy. When, and if, this occurs in the future, achievements of radiotherapy in this country should equal the splendid work done abroad.

Mayo Clinic
Rochester, Minnesota

REFERENCES

1. PORTMANN, U. V. Therapeutic radiology as a specialty. AM. J. ROENTGENOL. & RAD. THERAPY, 1950, *63*, 1–5.
2. QUICK, DOUGLAS. Therapeutic radiology; Carman lecture. *Radiology*, 1948, *50*, 283–296.

THE AMERICAN JOURNAL OF ROENTGENOLOGY, RADIUM THERAPY AND NUCLEAR MEDICINE

Editor: Lawrence Reynolds, M.D. *Assistant Editor:* Ruth Bigelow, B.S.

Associate Editors: Harry Hauser, M.D., Traian Leucutia, M.D., Russell H. Morgan, M.D., Edward B. D. Neuhauser, M.D., Wendell G. Scott, M.D.

Consulting Editorial Board: See front cover.

Published by: Charles C Thomas, Publisher, 301–327 East Lawrence Avenue, Springfield, Illinois.

Issued monthly. Annual subscription: United States, Mexico, Cuba, Central and South America, $15.00; Canada, $16.00; other countries, $17.00. Current single numbers, $1.50. Advertising rates submitted on application. Editorial office, 110 Professional Building, Detroit 1, Michigan. Office of publication, 301–327 East Lawrence Avenue, Springfield, Illinois. Information of interest to authors and readers will be found on page vi.

Officers and Standing Committees

AMERICAN ROENTGEN RAY SOCIETY

President: Harry M. Weber, Rochester, Minn.; *President-Elect*: Joshua C. Dickinson, Tampa, Fla.; *1st Vice-President*: Wilbur Bailey, Los Angeles, Calif.; *2nd Vice-President*: David G. Pugh, Rochester, Minn.; *Secretary*: Barton R. Young, Germantown Hospital, Philadelphia 44, Pa.; *Treasurer*: Wendell G. Scott, 35 North Central Ave., Clayton 5, Mo.

Executive Council: H. M. Weber, J. C. Dickinson, Wilbur Bailey, D. G. Pugh, B. R. Young, W. G. Scott, Lawrence Reynolds, E. L. Jenkinson, R. H. Morgan, E. B. D. Neuhauser, C. L. Martin, H. D. Kerr, H. O. Peterson, W. E. Chamberlain, Paul C. Hodges, Chairman, 950 East 59th St., Chicago 37, Illinois.

Program Committee: B. R. Young, Philadelphia, Pa., R. H. Morgan, Baltimore, Md., Lawrence Reynolds, Detroit, Mich., E. B. D. Neuhauser, Boston, Mass., P. C. Hodges, Chicago, Ill., Joshua C. Dickinson, Chairman, 603 Citizens Bldg., Tampa 2, Fla.,

Publication Committee: R. J. Reeves, Durham. N. C., M. J. Geyman, Santa Barbara, Calif., R. H. Morgan, Chairman, Baltimore, Md.

Finance Committee: J. L. Olpp, Englewood, N. J., R. K. Arbuckle, Oakland, Calif., E. L. Jenkinson, Chairman, Chicago, Ill.

Committee on Scientific Exhibits: C. A. Good, Rochester, Minn., W. A. Evans, Jr., Detroit, Mich., E. B. D. Neuhauser, Chairman, Boston, Mass.

Representatives on American Board of Radiology: B. R. Kirklin, Rochester, Minn., H. Dabney Kerr, Iowa City, Iowa, U. V. Portmann, Tucson, Ariz.

Representative on National Research Council: A. O. Hampton, Washington, D. C.

Editor: Lawrence Reynolds, 110 Professional Building, Detroit 1, Mich.

Assistant Editor: Ruth Bigelow, 110 Professional Building, Detroit 1, Mich.

Fifty-fifth Annual Meeting: Shoreham Hotel, Washington, D. C., September 21–24, 1954.

AMERICAN RADIUM SOCIETY

President: John E. Wirth, Pasadena, Calif.; *President-Elect:* Grant H. Beckstrand, Long Beach, Calif.; *1st Vice-President:* Norman A. McCormick, Windsor, Ont.; *2nd Vice-President:* W. Edward Chamberlain, Philadelphia, Pa.; *Secretary:* Robert E. Fricke, Mayo Clinic, Rochester, Minn.; *Treasurer:* Douglas J. Roberts, 85 Jefferson St., Hartford 6, Conn.

Executive Committee: Howard B. Hunt, Chairman, Omaha, Nebr., Hugh F. Hare, Los Angeles, Calif., Edith H. Quimby, New York, N. Y.

Program Committee: John E. Wirth, Chairman, Pasadena, Calif., James F. Nolan, Los Angeles, Calif., Jesshill Love, Louisville, Ky., Theodore R. Miller, New York, N. Y., Grant H. Beckstrand (ex officio), Long Beach, Calif.

Publication Committee: Harry Hauser, Chairman, Cleveland, Ohio, Martin Van Herik, Rochester, Minn., Jacob R. Fried, New York, N. Y.

Public Relations Committee: Robert L. Brown, Chairman, Emory University, Ga., John A. Wall, Houston, Texas, Calvin T. Klopp, Bethesda, Md.

Janeway Lecture Committee: Douglas Quick, Chairman, New York, N. Y., Gioacchino Failla, New York, N. Y., H. Dabney Kerr, Iowa City, Iowa.

Representatives on the American Board of Radiology: Douglas Quick, New York, N. Y., B. P. Widmann, Philadelphia, Pa., Frederick W. O'Brien, Boston, Mass.

Committee on Arrangements: Ralph M. Caulk, Chairman, Washington, D. C. Murray M. Copeland, Washington, D. C. John V. Blady, Philadelphia, Pa., Robert L. Brown, Emory University, Ga., John E. Wirth (ex officio), Pasadena, Calif.

Representatives on National Committee on Radiation Protection: Edith H. Quimby, New York, N. Y., Theodore P. Eberhard, Philadelphia, Pa.

Thirty-seventh Annual Meeting: Shoreham Hotel, Washington, D. C., April 21–23, 1955.

EDITORIALS

PROGRESS IN THE ROENTGEN VISUALIZATION OF THE BILIARY TRACT

SINCE 1952 several new opaque media containing three iodine atoms have been introduced for the roentgen visualization of the biliary tract. Some of them are devised for oral administration, others are intended primarily for intravenous use. Clinical evidence is now rapidly accumulating to the effect that all of these new media offer distinct advantages over the older di-iodo compounds. Because of their greater iodine content, they produce a higher degree of opacification as a whole and, in addition, frequently permit the demonstration of biliary tract structures which could not be visualized formerly.

In general, the orally administered tri-iodo compounds give a better opacification of the gallbladder, and a certain percentage of gallbladders found to be "nonfunctioning" with the di-iodo compounds will cast a visible shadow. Demonstration of the bile ducts in patients with functioning gallbladders can be accomplished with the use of these media by careful positioning of the patient for the roentgenograms and the use of multiple exposures at suitable intervals following ingestion of a fatty meal, as has been stressed by Shehadi[1] and Grugan.[2] Such satisfactory visualization of the bile duct system, particularly the common duct, has been obtained by this technique that the terms "nonsurgical" cholangiography, "medical" cholangiography, and "oral" cholangiography have appeared.

Opacification of the bile ducts by orally administered tri-iodo compounds mainly depends upon the ability of the patient's gallbladder to concentrate the contrast-laden bile as it is received from the liver. Where concentrating ability of the gallbladder is impaired, or when the gallbladder has been surgically removed, the media in their usual doses fail to satisfactorily delineate the bile ducts. However, Twiss, Beranbaum, Gillette and Poppel,[3] by administering multiple doses of tri-iodo compounds, have obtained bile duct visualization in approximately 85 per cent of a group of cholecystectomized patients. A significant result of their study is the finding of dilatation of the common duct in 70 per cent of patients suffering from biliary dyskinesia, while in asymptomatic postcholecystectomy patients none of the bile ducts were significantly dilated. This would seem to indicate that, as has been previously assumed, dysfunction of the sphincter mechanism of the common duct is an important factor in the production of biliary tract symptoms. Careful study of the status of the common duct and its sphincter is therefore advisable prior to cholecystectomy.

Recently a tri-iodo preparation[4,5] was introduced for intravenous use which, although containing slightly less iodine (64.32 per cent) than the oral preparations (66.50 to 66.68 per cent), promises to be of great value in the roentgen visualization of the biliary tract in almost any circumstance.

[1] Shehadi, W. H. Telepaque; new cholecystographic medium with improved visualization of gallbladder and visualization of bile ducts. AM. J. ROENTGENOL., RAD. THERAPY & NUCLEAR MED., 1952, *68*, 360–368.

[2] Grugan, R. A. Oral cholecystographic method using telepaque with demonstration of common and cystic ducts. *Radiology*, 1953 *61*, 633–636.

[3] Twiss, J. R., Beranbaum, S. A., Gillette, L., and Poppel, M. H. Post-cholecystectomy. Oral cholangiography; preliminary report. *Am. J. M. Sc.*, 1954, *227*, 372–386.

[4] Frommhold, W. Ein neuartiges Kontrastmittel für die intravenöse Cholezystographie. *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, 1953, *79*, 283–291.

[5] Gaebel, E., and Teschendorf, W. Darstellung der Gallenwege mit Biligrafin (Schering). Unblutige Cholangiographie. *Röntgen-Blätter*, 1953, *6*, 162–170.

Since the cycle of intestinal absorption is eliminated and the medium rapidly reaches the liver via the circulatory route, a concentration great enough to allow visualization of the bile ducts occurs with this preparation even if the gallbladder's concentrating power is lost or if the gallbladder is absent. Concentration of the substance in the bile ducts depends so directly upon the functional status of the liver that the substance may also prove to be useful in assessment of hepatic function. Severe liver dysfunction and jaundice are factors which unfortunately prevent visualization of the biliary tree by this medium. In patients with intact gallbladders the intravenously injected contrast medium initially demonstrates the major intrahepatic bile radicals, the hepatic ducts and the common duct.[5] Later a good filling of the gallbladder is obtained and a cholecystogram equal in quality to that obtained with oral tri-iodo media appears. This sequence of visualization of portions of the biliary tree, *i.e.*, bile ducts first, then cystic duct and gallbladder, confirms the previous concepts of the physiology of the bile duct system based on nonroentgenologic evidence, and has led Nemours-Auguste and Barag[6] to propose the term "cholangio-cholecystography."

Designated "intravenous cholecystography and cholangiography" in this country by Berk, Karnofsky, Shay and Stauffer[7] to distinguish it from the oral and surgical methods, the intravenous technique has already found widespread use. Several publications in the foreign literature have appeared within recent months stressing the use of the medium. Caroli, Porcher, Gilles, Ledoux and Charpentier[8] studied 110 cases dealing primarily with visualization of the biliary system after cholecystectomy or with a poorly concentrating gallbladder. They found the bromsulphalein test to be a good index of successful visualization of the bile ducts by the intravenous medium. Retention of more than 30 per cent of the bromsulphalein by the liver in forty-five minutes usually results in nonvisualization of the common duct when cholangiography is attempted.

Sénèque, Le Canuet, Debray, Roux and Aussage[9] have reported comprehensively concerning the place of cholangiography by the intravenous route in the roentgenologic study of the biliary tract. These authors recommend that: (1) Roentgenologic exploration of the biliary tract of a noncholecystectomized patient should commence with oral cholecystography; (2) intravenous cholangiography should be carried out in all cases in which visualization of the gallbladder and principal bile ducts is not possible by the oral route; (3) in cholecystectomized patients, the intravenous method is the only one permitting roentgenologic study of the biliary tract; and (4) intravenous cholangiography allows study of the functional disorders of the biliary tract, which until now have been only poorly understood.

It is apparent from the foregoing that roentgen visualization of the gallbladder alone (cholecystography) no longer constitutes an acceptable study of a patient with symptoms referable to the biliary tract. The entire biliary tree must be visualized. The tri-iodo cholecystographic and cholangiographic media now available for such investigation will stimulate a more comprehensive study of the biliary tract which may eventually lead to a greater understanding of its physiology and diseases.

Harold Fulton, M.D.

Harper Hospital
Detroit 1, Michigan

[6] Nemours-Auguste, S., and Barag, N. Cholangio-cholécystographie; considérations préliminaires sur 100 observations—action pharmacodynamique. *Presse méd.*, 1954, *62*, 300–304.

[7] Berk, J. E., Karnofsky, R. E., Shay, H. E., and Stauffer, H. M. Intravenous cholecystography and cholangiography; report of preliminary observations. *Am. J. M. Sc.*, 1954, *227*, 361–371.

[8] Caroli, J., Porcher, P., Gilles, Ev., Ledoux, J., and Charpentier. La place de l'angiocholégraphie intraveineuse dans le diagnostic des affections de la voie biliare principale. *Arch. mal. app. digest.*, 1954, *43*, 285–304.

[9] Sénèque, J., Le Canuet, R., Debray, Ch., Roux, M., and Aussage, J. La cholangiographie par voie veineuse; sa place dans l'exploration radiologique des voies biliaires. *Presse méd.*, 1954, *62*, 281–285.

I. GONZÁLEZ MARTÍNEZ, M.D., F.A.C.R.
1871-1954

IN THE early hours of the morning of April 20, 1954, Dr. I. González Martínez died of coronary occlusion while reading a book on nuclear physics. His countenance was placid and reflected that when death arrived he met it with the same coolness with which he met sorrows and adversities in life. This Puerto Rican gentleman who was born to be a physician, died after living a professional life unique in our medical history. His vocation, devotion to his patients, great medical accomplishments and

personal sacrifice should serve as an example to our young generation of medical doctors.

The Commencement Exercises of the first graduating class, Medical School of the University of Puerto Rico were dedicated to him. No better figure of our medical history could have been chosen. Let us hope that these new medical men and women follow the path during their professional lives that Dr. González Martínez so beautifully traced for them.

Dr. González Martínez was born on July 8, 1871, on a coffee plantation at Caguana, a rural area near Utuado, Puerto Rico. There he spent his early childhood and received his primary instruction in a rural school. At ten years of age he was brought by his father to the larger town of Mayaguez and later to a well known school at Maricao where he received his Bachelor's degree in 1890. From 1890 to 1892 he taught history and mathematics in the same school. In 1892 he decided to study Medicine and left for Spain, entering the University of Barcelona from which he received his degree as licentiate of Medicine in 1897. That same year he returned to Puerto Rico and began general practice in the city of Mayaguez. Very soon he acquired a reputation as a diagnostician and surgeon. He was among the first to do hysterectomies with success in Puerto Rico. In 1900 he returned to Europe and took postgraduate courses in Paris, Germany and Austria in gynecology and urology. Then he defended in Spain a thesis and obtained his degree as Doctor of Medicine. At the end of 1900 he returned to Puerto Rico and resumed his interrupted practice. He became interested in parasitology and in 1904 discovered the first case of intestinal bilharziasis in Puerto Rico, and in the same year the first case of distomatosis of the liver. In 1913 he reported the existence of canine Piroplasmosis in this island, and months later reported the first case of ainhum. In 1911, he became interested in the new field of radiology and took a course in the New York Post Graduate Medical School under Drs. Meyer and Quimby. In 1928 he returned to Europe and studied radiotherapy with Regaud and Monod; later, with Fraesser in Vienna, and also on the service of Dr. Holzknecht. He also spent several months in Germany on the services of Wintz and Holfelder.

After this training he returned to Puerto Rico and from 1930 until his death devoted all the rest of his life to the science of radiology. He wrote hundreds of medical articles in the leading medical journals of the world and contributed in a large measure toward raising the standard of life and of medical practice in the island.

It was when he was sixty-three years of age, usually near the end of the career of any man, when he already had received recognition and respect in the medical world, and was beloved in Puerto Rico by his patients and friends, that he undertook his most difficult but greatest of his achievements and tasks, the foundation of the Puerto Rican League against Cancer, and later the Institute of Oncology, operated by the League. Since its foundation in 1938, he devoted all his time without compensation, to the cause of the League. He used his office and equipment to treat all the poor victims of cancer and organized a network of subcommittees all over the island. Soon the public and his friends realized the tremendous task and magnificent service that Dr. González was giving his fellow citizens and the League began to receive the grateful support of the people of Puerto Rico. He personally conducted all the campaigns for public education on the danger signals of cancer and thus made the people of the island cancer conscious. The Institute of Oncology which he created is a small hospital with modest physical facilities. However, before his death, he received two great satisfactions. One was the laying of the cornerstone for the new modern Institute of Oncology. The other great satisfaction was the news personally conveyed to him by the Chancellor of the University, that he was going to be the recipient of an honorary distinction to

be bestowed upon him by our School of Medicine during the graduation ceremonies of our first graduating class in June, 1954.

Dr. González Martínez received honorary degrees from several foreign Latin American countries; was made a Diplomate of the American Board of Radiology and until his death was counselor of the Inter-American College of Radiology in Puerto Rico. He belonged to many international medical societies, and was also first President of the Radiological Society of Puerto Rico and Honorary President of the same. During 1922–1923 he was President of the Medical Association of Puerto Rico. He occupied in his early career important positions in our Health Department and found time for numerous civic activities. He was President of the Casino de Puerto Rico for several years and in the first half of his professional life took an active part in the political development of the island. During the Spanish domination of the island he joined the Autonomy Party, later the Union of Puerto Rico and finally the Republican Party which advocates statehood for the island. Like the majority of Puerto Ricans in 1917 he favored our becoming full-fledged American citizens. Even though he was a product of European culture, he adapted himself to the American way of life and thinking. He took pride in his American citizenship and on the establishment of the most complete ties between Puerto Rico and the mainland. He was conscious of the great difficulties that statehood for Puerto Rico would encounter, and thought of it as an ideal difficult to materialize. In all, I believe, he was satisfied with the present Commonwealth Status of Associated Free State.

We shall always remember Dr. González Martínez as the white haired gentleman, of small penetrating eyes, always punctual and correctly attired, with an exquisite sense of humor, and an insatiable desire for more and more medical knowledge. He was sharp and witty in conversation, master of the Spanish language and formality, tenacious and forceful in debate, but with the most generous and kind heart we have known.

He is survived by his wife, a son, two daughters and four grandchildren.

His life was his profession, above all family relations. His death is a great loss to his family, to the radiological world and an irreparable one to Puerto Rico. Dr. González Martínez fulfilled his duty to a greater degree than most men do. He will forever live in the hearts of the people of Puerto Rico. Honor to Whom Honor Deserves.

Rafael A. Blanes, M.D.

CARL DARNELL

Carl Darnell, pioneer in the concept and development of high voltage roentgen-ray equipment for cancer therapy, and authority on roentgen-ray physics, died on July 28, 1954, at Laguna Beach, California.

Widely known throughout the medical profession, Mr. Darnell held the post of commercial engineer with the X-Ray Department of General Electric Co., from

which he retired in 1946 after twenty-nine years of service, which dated from 1917 when he joined the Research Laboratory staff at Schenectady, New York.

He later joined the X-Ray Department in Chicago, where he achieved recognition among radiologists throughout the American continent as an authority on roentgen-ray physics, particularly as it pertains to high voltage roentgen radiation used in the treatment of tumors. He was especially active during the period when 200 and 400 kv. roentgen-ray apparatus was first applied for therapeutic purposes.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. Barton R. Young, Germantown Hospital, Philadelphia 44, Pa. Annual meeting: Shoreham Hotel, Washington, D.C., Sept. 21–24, 1954.

AMERICAN RADIUM SOCIETY
Secretary, Dr. R. E. Fricke, Mayo Clinic, Rochester, Minn. Annual meeting: Shoreham Hotel, Washington, D. C., April 21–23, 1955.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 713 E. Genesee St., Syracuse 2, N. Y. Annual meeting: Biltmore Hotel, Los Angeles, Calif., Dec. 5–10, 1954.

AMERICAN COLLEGE OF RADIOLOGY
Executive Secretary, William C. Stronach, 20 N. Wacker Drive, Chicago 6, Illinois.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. T. Leucutia, Harper Hospital, Detroit 1, Mich.

FIFTH INTER-AMERICAN CONGRESS OF RADIOLOGY
Secretary-General, Dr. Eugene P. Pendergrass, 3400 Spruce St., Philadelphia 4, Pa. Meets at Shoreham Hotel, Washington, D. C., April 24–29, 1955.

ALABAMA RADIOLOGICAL SOCIETY
Secretary, Dr. J. A. Meadows, Jr., Medical Arts Bldg., Birmingham 5, Ala. Meets time and place Alabama State Medical Association.

ARIZONA RADIOLOGICAL SOCIETY
Secretary, Dr. R. Lee Foster, 507 Professional Bldg., Phoenix, Ariz. Two regular meetings a year. The annual meeting at time and place of State Medical Association and interim meeting six months later.

ARKANSAS RADIOLOGICAL SOCIETY
Secretary, Dr. J. A. Norton, 843 Donaghey Bldg., Little Rock, Ark. Meets every three months and also at time and place of State Medical Association.

ATLANTA RADIOLOGICAL SOCIETY
Secretary, Dr. Albert A. Rayle, Jr., 478 Peachtree St., N.E., Atlanta, Ga. Meets monthly, except during three summer months, on second Friday evening.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. J. J. Daversa, 345 75th St., Brooklyn, N. Y. Meets monthly fourth Tuesday, October through April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary, Dr. Clayton G. Weig, 135 Linwood Ave., Buffalo, N. Y. Meets second Monday evening each month, October to May inclusive.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. Dwight V. Needham, 608 E. Genesee St., Syracuse N. Y. Meets January, May, November.

CENTRAL OHIO RADIOLOGICAL SOCIETY
Secretary. Dr. F. A. Riebel, 15 West Goodale St., Columbus, Ohio. Meets at 6:30 P.M. on second Thursday of October, December, February, April, and June at Columbus Athletic Club, Columbus, Ohio.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. E. Burns Lewis, 670 N. Michigan Ave., Chicago 11, Ill. Meets second Thursday of each month, October to April inclusive at the University Club.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Mortimer Lubert, 10515 Carnegie Ave., Cleveland 6, Ohio. Meetings at 6:45 P.M. on fourth Monday of each month from October to April.

COLORADO RADIOLOGICAL SOCIETY
Secretary, Dr. Parker Allen, Children's Hospital, Denver, Colo. Meets third Friday of each month at University of Colorado Medical Center or at Denver Athletic Club.

CONNECTICUT VALLEY RADIOLOGIC SOCIETY
Secretary, Dr. B. B. Alicandri, 20 Maple St., Springfield, Mass. Meets second Friday October and April.

DALLAS-FORT WORTH RADIOLOGICAL CLUB
Secretary, Dr. O. H. Grunow, 650 Fifth Ave., Fort Worth, Texas. Meets monthly, third Monday, at Greater Fort Worth International Airport at 6:30 P.M.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. F. Lang, Harper Hospital, Detroit, Mich. Meets monthly first Thursday, Oct. through May, at David Whitney House, 4421 Woodward Ave., at 6:30 P.M.

EAST BAY ROENTGEN SOCIETY
Secretary, Dr. Dan Tucker, 434 30th St., Oakland 9, Calif. Meets first Thursday each month at Peralta Hospital, Oakland.

FLORIDA RADIOLOGICAL SOCIETY
Secretary, Dr. J. T. Shelden, Box 1021, Lakeland, Fla. Meets twice annually, in the spring with the annual State Society meeting, and in the fall.

GEORGIA RADIOLOGICAL SOCIETY
Secretary, Dr. Herbert M. Olnick, 417 Persons Bldg., Macon, Ga. Joint meeting with Florida State Medical Association, November, 1954.

GREATER MIAMI RADIOLOGICAL SOCIETY
Secretary, Dr. R. D. Shapiro, 541 Lincoln Rd., Miami Beach, Fla. Meets monthly at various South Florida Hospitals.

HOUSTON RADIOLOGICAL SOCIETY
Secretary, Dr. Harry Fishbein, 324 Medical Arts Bldg., Houston 2, Texas. Meets fourth Monday each month at Hermann Hospital.

IDAHO STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Alfred M. Stone, St. Lukes Hospital, Boise, Idaho. Meets annually at same time as Idaho State Medical Association.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. Stephen L. Casper, 1101 Maine St., Quincy, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. John A. Robb, 238 Hume-Mansur Bldg., Indianapolis 4. Meets first Sunday in May and during fall meeting of Indiana State Medical Association.

IOWA RADIOLOGICAL SOCIETY
Secretary, Dr. James T. McMillan, 1104 Bankers Trust Bldg., Des Moines, Iowa. Luncheon and business meeting during annual session of Iowa State Medical Society. The scientific section is held in the autumn.

KANSAS RADIOLOGICAL SOCIETY
Secretary Dr. A. M. Cherner, Hays, Kansas. Meets in spring with State Medical Society, and in winter on call.

KENTUCKY RADIOLOGICAL SOCIETY
Secretary, Dr. David Shapiro, 323 East Chestnut St., Louisville 2, Ky. Meets monthly on second Friday at Seelbach Hotel, Louisville.

KINGS COUNTY RADIOLOGICAL SOCIETY
Secretary, Dr. Solomon Maranov, 1450 51st St., Brooklyn 19, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:45 P.M.

LOS ANGELES RADIOLOGICAL SOCIETY
Secretary, Dr. Oscar Harvey, 3741 Stocker St., Los Angeles 8, Calif. Meets second Wednesday each month at Los Angeles County Medical Association Building, Los Angeles.

* Secretaries of societies are requested to send timely information promptly to the Editor.

Maine Radiological Society
Secretary, Dr. Jack Spencer, Maine General Hospital, Portland 4, Maine. Meets in early spring, June and fall.

Maryland Radiological Society
Secretary-Treasurer, Dr. Paul W. Roman, 1810 Eutaw Place, Baltimore 17, Maryland.

Miami Valley Radiological Society
Secretary, Dr. G. A. Nicoll, 134 Apple St., Dayton, Ohio. Meets second Friday of fall and winter months.

Mid-Hudson Radiological Society
Secretary, Dr. J. W. Walton, Horton Memorial Hospital, Middletown, N. Y. Meets 8:30 P.M., fourth Tuesday each month, September to May.

Milwaukee Roentgen Ray Society
Secretary, Dr. R. W. Byrne, 3321 N. Maryland Ave., Milwaukee 11, Wis. Meets monthly on fourth Monday at University Club.

Minnesota Radiological Society
Secretary, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minn. Meets three times annually, once at time of State Med. Assn., and in spring and fall.

Mississippi Radiological Society
Secretary, Dr. John W. Evans, 117 N. President St., Jackson, Miss. Meets third Thursday of each month at the Rotisserie Restaurant at 6:30 P.M.

Montana Radiological Society
Secretary, Dr. Grant P. Raitt, Suite 413 Medical Arts Bldg., Billings, Montana. Meets at least once a year.

Nassau Radiological Society
Secretary, Dr. Alan E. Baum, Hicksville, N. Y. Meets second Tuesday of the month in February, April, June, October and December.

Nebraska Radiological Society
Secretary, Dr. J. F. Kelly, Jr., 816 Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England Roentgen Ray Society
Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston, Mass. Meets monthly on third Friday, Harvard Club.

New Hampshire Roentgen Ray Society
Secretary, Dr. A. C. Johnston, Elliott Community Hospital, Keene, N. H. Meets four to six times yearly.

New York Roentgen Society
Secretary, Dr. Sidney Rubenfeld, 477 First Ave., New York 16, N. Y. Meets monthly on third Monday, New York Academy of Medicine, at 8:30 P.M.

North Carolina Radiological Society
Secretary, Dr. W. C. Sternbergh, Charlotte Memorial Hospital, Charlotte, N. C. Meets in May and October.

North Dakota Radiological Society
Secretary, Dr. C. O. Heilman, 807 Broadway, Fargo. Meetings by announcement.

North Florida Radiological Society
Secretary, Dr. Ivan Isaacs, 1645 San Marco Blvd., Jacksonville, Florida. Meets quarterly in March, June, September and December.

Northeastern New York Radiological Society
Secretary, Dr. D. H. Baxter, Albany Hospital, Albany, N. Y. Meets in Albany area on second Wednesdays of October, November, March and April.

Northern California Radiological Society
Secretary, Dr. H. B. Stewart, 2920 Capitol Ave., Sacramento, Calif. Meets at dinner last Monday of each month, September to June.

Ohio State Radiological Society
Secretary, Dr. M. M. Thompson, Jr., 319 Toledo Medical Bldg., Toledo 2, Ohio.

Oklahoma State Radiological Society
Secretary, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City, Okla. Three regular meetings annually.

Oregon Radiological Society
Secretary, Dr. F. C. Shipps, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets monthly from October to June on the second Wednesday of each month at 8:00 P.M. at the University Club.

Orleans Parish Radiological Society
Secretary, Dr. Joseph V. Schlosser, Charity Hospital, New Orleans 13, La. Meets first Tuesday of each month.

Pacific Northwest Radiological Society
Secretary, Dr. J. R. Raines, 214 Medical-Dental Bldg., Portland 5, Oregon. Meets annually in May.

Pacific Roentgen Society
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
Secretary, Dr. J. M. Converse 416 Pine St., Williamsport. Next annual meeting at Berkshire Hotel, Reading, Penna., May 20 and 21, 1955.

Philadelphia Roentgen Ray Society
Secretary, Dr. H. M. Stauffer, Temple University Hospital, Philadelphia 40, Pa. Meets first Thursday of each month, at 5 P.M., from October to May in Thompson Hall, College of Physicians.

Pittsburgh Roentgen Society
Secretary, Dr. Donald H. Rice, Western Pennsylvania Hospital, Pittsburgh 24, Pa. Meets second Wednesday of month, October through June at Hotel Roosevelt.

Radiological Section, Baltimore Medical Society
Secretary, Dr. H. Leonard Warres, 2337 Eutaw Place, Baltimore 17, Md. Meets third Tuesday each month, September to May, inclusive.

Radiological Section, Connecticut Medical Society
Secretary, Dr. William A. Goodrich, 85 Jefferson St., Hartford 6, Conn. Meetings are held bi-monthly.

Radiological Section, Southern Medical Association
Secretary, Dr. Roy G. Giles, Temple, Texas.

Radiological Society of Greater Cincinnati
Secretary, Dr. Chapin Hawley, 927 Carew Tower, Cincinnati 2, Ohio. Meets monthly from September to June on first Monday of each month at 7:30 P.M. at the Cincinnati General Hospital.

Radiological Society of Hawaii
Secretary, Dr. H. C. Chang, 1282 Emma St., Honolulu 13, T. H. Meets third Monday evening of each month at designated hospitals.

Radiological Society of Kansas City
Secretary, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month.

Radiological Society of Louisiana
Secretary, Dr. J. T. Brierre, 700 Audubon Bldg., New Orleans. Meets annually during Louisiana State Medical Society Meeting.

Radiological Society of New Jersey
Secretary, Dr. Carye-Belle Henle, 195 North 7th St., Newark, N. J. Meets at Atlantic City at time of State Medical Society and in November in Newark, N. J.

Radiological Society of Southern California
Secretary, Dr. George Jacobson, 1200 N. State St., Los Angeles 33, Calif.

Richmond County Radiological Society
Secretary, Dr. W. F. Hamilton, Jr., University Hospital, Augusta, Ga. Meets first Thursday of each month at various hospitals.

Rochester Roentgen Ray Society, Rochester, N. Y.
Secretary, Dr. Henry H. Forsyth, Jr., 40 Meigs St., Rochester, N. Y. Meets at 8:15 P.M. on the last Monday of each month, September through May, at Strong Memorial Hospital.

Rocky Mountain Radiological Society
Secretary, Dr. John H. Freed, 4200 East Ninth St., Denver 7, Colo. Meets at Shirley-Savoy Hotel, Denver, Colo., Aug. 19–21, 1954.

St. Louis Society of Radiologists
Secretary, Dr. W. B. Seaman, 510 South Kingshighway, St. Louis 10, Mo. Meets fourth Wednesday each month, except June, July, August and September.

San Antonio-Military Radiological Society
Secretary, Dr. Hugo F. Elmendorf, Jr., 730 Medical Arts Bldg., San Antonio 5, Texas. Meets Brook Army Medical Center Officers Mess first Monday of each month.

San Diego Radiological Society
Secretary, Dr. C. W. Bruner, 2456 Fourth Ave., San Diego 1, Calif. Meets first Wednesday of each month at the University Club.

San Francisco Radiological Society
Secretary, Dr. I. J. Miller, 2680 Ocean Avenue, San Francisco 27, Calif. Meets quarterly.

Section on Radiology. California Medical Association
Secretary, Dr. H. R. Morris, 1027 "D" St., San Bernardino, Calif.

Section on Radiology, Medical Society of the District of Columbia
Secretary, Dr. John A. Long, 1801 K St., N.W., Washington 6, D. C. Meets Medical Society Library, third Wednesday of January, March, May and October at 8:00 P.M.

Section on Radiology, Illinois State Medical Society
Secretary, Dr. George E. Irwin, Jr., 703 N. East St., Bloomington, Ill.

Shreveport Radiological Club
Secretary, W. R. Harwell, 608 Travis St., Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M. September to May inclusive.

South Bay Radiological Society
Secretary, Dr. H. R. Berman, 309 St. Claire Bldg., San Jose, Calif. Meets second Wednesday of each month.

South Carolina Radiological Society
Secretary, Dr. William A. Klauber, Self Memorial Hospital, Greenwood, S. C. One meeting with South Carolina Medical Association in May, others arranged by President.

Tennessee Radiological Society
Secretary, Dr. G. K. Henshall, 311 Medical Arts Bldg., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary, Dr. R. P. O'Bannon, 650 Fifth Ave., Fort Worth 4, Texas. Next meeting, Houston, Texas, January 21 and 22, 1955.

Tri-State Radiological Society
Secretary, Dr. S. N. Tager, 219 Walnut St., Evansville, Ind. Meets last Wednesday of Oct., Jan., March and May, 8:00 P.M. at Elks' Club in Evansville.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7:00 P.M. at University Hospital.

University of Wisconsin Radiological Conference
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets first and third Thursdays 4:00 to 5:00 P.M., September to May, Service Memorial Institute.

Utah State Radiological Society
Secretary, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1, Utah. Meets fourth Wednesday in January, March, May, September and November at Holy Cross Hospital.

Virginia Radiological Society
Secretary, Dr. P. B. Parsons, Norfolk General Hospital, Norfolk, Va. Meets annually in October.

Washington State Radiological Society
Secretary, Dr. Eva L. Gilbertson, 1317 Marion St., Seattle 4, Wash. Meets fourth Monday of each month from September through May at 610 Pine St., Seattle.

West Virginia Radiological Society
Secretary, Dr. W. Paul Elkin, 515 Medical Arts Bldg., Charleston, W. Va. Meets concurrently with annual meeting of West Virginia State Medical Society; other meetings arranged by program committee.

Westchester Radiological Society
Secretary, Dr. M. G. Priestman New Rochelle Hospital, New Rochelle, N.Y. Meets on third Tuesday of January and October and on two other dates.

Wisconsin Radiological Society
Secretary, Dr. W. W. Moir, 309 Geele Ave., Sheboygan, Wis. Special meetings held during year; annual meeting each spring at Madison, Wis.

X-Ray Study Club of San Francisco
Secretary, Dr. Wm. W. Saunders, Veterans Administration Hospital, San Francisco 21, Calif. Meets monthly, third Thursday, at 7:45 P.M., Lane Hall, Stanford University Hospital.

Cuba, Mexico, Puerto Rico and Central America

Sociedad de Radiología y Fisioterapia de Cuba
President, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

Sociedad Mexicana de Radiología, A. C.
Secretary General, Dr. Eugenio Toussaint, Calle del Oro No. 15, Mexico 7, D.F. Meets first Monday of each month.

Asociación Puertorriqueña de Radiología
Secretary, Dr. Rafael A. Blanes, Ave. Ponce de Leon 1175, Santurce, P. R.

Sociedad Radiológica Panameña
Secretary, Dr. L. Arrieta Sanchez, Apartado No. 86, Panama, R. de P. Meets monthly in a department of radiology of a local hospital, chosen at preceding meeting.

British Empire

Association of Radiologists of the Province of Quebec
Secretary, Dr. J.-P. Jean, 4039 Tupper St., Westmount, Que.

British Institute of Radiology Incorporated with the Röntgen Society
Ordinary meeting, on the Thursday preceding the third Friday, October to May at 8:15 P.M.
Medical Members' meeting, on third Friday in each month at 5:00 P.M., 32 Welbeck St., London, W 1.

Faculty of Radiologists
Honorary Secretary, Dr. J. F. Bromley, 45, Lincoln's Inn Fields, London, W.C.2, England.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets third Friday each month at 4:45 P.M. at the Royal Society of Medicine, 1 Wimpole St., London.

Canadian Association of Radiologists
Honorary Secretary-Treasurer, Dr. D. L. McRae, Suite 305, 1555 Summerhill Avenue, Montreal 25, Que. Meetings January and June.

Section of Radiology, Canadian Medical Association
Secretary, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Société Canadienne-Française d'Electro-Radiologie Médicales
General Secretary, Dr. Ls Ivan Vallée, 1058 rue St-Denis, Montreal 18, Canada. Meets third Saturday each month.

College of Radiologists (Australia and New Zealand)
Honorary Secretary, Dr. Alan R. Colwell, c/o British Medical Agency, 135 Macquarie St., Sydney, N.S.W.

South America

Asociacion Argentina de Radiologia
Secretary, Dr. Lidio G. Mocsa, Avda. Gral. Paz 151, Córdoba, Argentina. Meetings held monthly.

Sociedad Argentina de Radiologia, Junta Central, Buenos Aires
Secretary, Dr. Oscar F. Noguera, Santa Fe 1171, Buenos Aires. Meetings are held monthly.

Sociedad Argentina de Radiologia, Filial del Litoral, Sede, Rosario
President, Dr. Francisco P. Cifarelli. Meets monthly second Wednesday, 19 ha 663 Italia St., Rosario, Santa Fe.

Sociedad Argentina de Radiologia, Filial del Sur, Sede, La Plata
President, Prof. Dr. Jose P. Uslenghi, La Plata. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Centro Sede, Cordoba
President, Prof. Dr. David L. Caro, Corro 86, Cordoba. Meets monthly.

Sociedad Argentina de Radiologia, Filial del Norte, Sede, Tucuman
President, Dr. Julio Mendez Valladares, Rivadavia 358, Tucuman. Meets monthly.

Sociedad Argentina de Radiologia, Filial de Cuyo Sede, Mendoza.
President, Dr. J. A. Orfila, Hospital Central, Mendoza. Meets monthly.

Sociedade Brasileira de Radiologia Medica
Secretary, Dr. Nicola Caminha, Av. Mem de Sa, Rio de Janeiro, Brazil. Meets monthly, except during January, February and March.

Sociedade Brasileira de Radioterapia
Secretary, Dr. Oscar Rocha von Pfuhl, Av. Brigadeiro Luiz Antonio, 644 São Paulo, Brazil. Meets monthly on second Wednesday at 9:00 P.M. in São Paulo at Av. Brigadeiro Luiz Antonio, 644.

Sociedad Colombiana de Radiologia
Secretary, Dr. Luis E. Lozano B., Carrera 12 No. 20–69, 6° piso, Bogota, Colombia. Meets last Thursday of each month.

Sociedad Peruana de Radiologia
Secretary, Dr. Julio Bedoya Paredes, Apartado 2306, Lima, Peru. Meets monthly except during January, February and March, at Asociación Médica Peruana "Daniel A. Carrión," Villalta, 218, Lima.

Sociedad de Radiologica, Cancerologia y Fisica Medica del Uruguay
Secretary, Dr. Arias Bellini, Av. Agraciada 1464, Piso 13, Montevideo, Uruguay.

Continental Europe

Société Belge de Radiologie
General Secretary, Dr. S. Masy, 111 Avenue des Allies, Louvain, Belgium. Meets monthly, second Sunday at Maison des Médecins, Brussels.

Société Française d'Electro-Radiologie Médicale, and its branches: Société du Sud-Ouest, du Littoral Méditerranéen, du Centre et du Lyonnais, de l'Ouest, de l'Est, et d'Alger et d'Afrique du Nord
Secretary-General, Dr. A. Dariaux, 9 bis, Boulevard Rochechouart, Paris IX°, France.

Ceskoslovensk společnost pro rëntgenologii a Radiologii v Praze
Secretary, Dr. Roman Bláha, Praha XII, stát. nemocnice, Czechoslovakia. Meets monthly except during July, August, and September. Annual general meeting.

Deutsche Röntgen-Gesellschaft
Secretary, Dr. med. Peter Kröker, Evangelisches Krankenhaus, Huyssens Stiftung, (22a) Essen. Annual meeting, Sept. 5–8, 1954, Wiesbaden, Germany.

Societa Italiana di Radiologia Medica
Secretary, Prof. Mario Ponzio, Ospedale Mauriziano. Torino, Italy. Meets biannually.

Nederlandse Vereniging voor Electrologie en Roentgenologie
Secretary, Dr. B. J. Rethmeier, Bornsestraat 378, Almelo, Netherlands.

Polish Society of Radiology
Secretary, Dr. L. Zgliczynski, 59 Nowogrodzka St., Warsaw, Poland.

Gdansk Section, Polish Society of Radiology
Secretary, Dr. A. Smigielska, Akademia Lekarska, Gdansk. Meets monthly last Sunday at 10:30, X-Ray Dept.. Akademia Gdansk.

Wrocław Section, Polish Society of Radiology
Secretary, Dr. R. Marciniak, Akad. Medyczna Wrocław, 68 Curie-Skłodowska St., Wrocław, Poland. Meets first Sunday of each month, X-Ray Department, Akademia Medyczna Wrocław.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Oscar Meller, Str. Banual Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad
USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

Sociedad Espanola de Radiologia y Electrologia
Secretary, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Schweizerische Röntgen-Gesellschaft (Société Suisse de Radiologie)
Secretary, Dr. Max Hopf, Effingerstrasse 47, Bern, Switzerland.

India

Indian Radiological Association
Secretary, Dr. R. F. Sethna, Navsari Building, Hornby Road, Bombay 1, India.

CONFERENCE ON ELECTRICAL TECHNIQUES IN MEDICINE AND BIOLOGY

The Seventh Annual Conference on Electrical Techniques in Medicine and Biology will be held at the Morrison Hotel, Chicago, Illinois, November 10, 11 and 12, 1954, under the sponsorship of the American Institute of Electrical Engineers, Institute of Radio Engineers and Instrument Society of America.

Three sessions will be devoted to technical papers, many of which deal with subjects of interest to radiologists. The program on Wednesday morning, November 10, takes up "Circulation and Cardiology;" on Wednesday afternoon, "Electrical Properties of Biological Materials," and on Thursday afternoon, "X-Rays and Instrumentation."

A dinner and evening meeting are scheduled for the evening of November 10. The guest speaker will be Dr. T. E. Allibone, Director of Research of the Associated Electrical Industries of Great Britain. Dr. Allibone is a Fellow of the Royal Society and known internationally for his work in fields pertinent to the Conference.

Two laboratory field trips have been arranged. Registrants for the Conference will be given an opportunity to visit the Argonne Cancer Research Hospital on the morning of November 11. This will include inspection of the 50 mev. microwave linear accelerator, the cobalt-60 rotational therapy unit, the thulium diagnostic unit, etc. On the morning of November 12, there will be an opportunity to visit appropriate portions of the Argonne National Laboratory. Both these installations, operated by the University of Chicago for the United States Atomic Energy Commission, are engaged in important studies of the effects of radiation on living systems.

The Conference Chairman is Mr. E. Dale Trout, 4855 Electric Avenue, Milwaukee 1, Wisconsin, from whom further information may be obtained.

CONTINUATION COURSE IN RADIOLOGY

The University of Minnesota announces its annual Continuation Course in Radiology for Specialists which will be held at the Center for Continuation Study on the University campus November 9 to 13, 1954. Bone and Joint Diseases will be the subject of this year's course. Guest faculty will include Dr. C. Howard Hatcher, Professor of Orthopedic Surgery, University of Chicago School of Medicine; Dr. Paul C. Hodges, Professor, Department of Radiology, University of Chicago School of Medicine; Dr. John F. Holt, Professor, Department of Radiology, University of Michigan Medical School, Ann Arbor; Dr. G. S. Lodwick, Chief, Department of Radiology, Veterans Administration Hospital, and Clinical Assistant Professor, Department of Radiology, State University of Iowa College of Medicine, Iowa City; Dr. Edward B. D. Neuhauser, Associate Radiologist, Harvard Medical School, Boston; and Dr. Isidore Snapper, Director of Medicine and Medical Education, Beth-El Hospital, Brooklyn, New York. The course will be presented under the direction of Dr. Leo G. Rigler, Professor and Head, Department of Radiology, and the remainder of the faculty will include members of the faculty of the University of Minnesota Medical School and of the Mayo Foundation. Lodging and meal accommodations are available at the Center for Continuation Study.

INTERNATIONAL COURSE ON TOMOGRAPHY

The third International Course on Tomography will be held at the Radiology Institute, University of Genoa, under the direction of Prof. Alessandro Vallebona. The course will last ten days and will deal particularly with recent progress in tomographical methods. The period September–October, 1955, has been chosen for this meeting in order to have the opportunity of celebrating the twenty-fifth anniversary of the first scientific publication and of the first practical realization of the tomographic method. All of those who contemplate participating in this course should communicate as soon as possible with Prof. Alessandro Vallebona, Istituto di Radiologia dell'Università, Genoa, Italy.

ANNOUNCEMENT OF THE VAN METER PRIZE AWARD

The American Goiter Association again offers the Van Meter Prize Award of three hundred dollars and two honorable mentions for the best essays submitted concerning original work on problems related to the thyroid gland. The award will be made at the annual meeting of the Association which will be held in Oklahoma City, Oklahoma, April 28, 29 and 30,

1955, providing essays of sufficient merit are presented in competition.

The competing essays may cover either clinical or research investigations; should not exceed three thousand words in length; must be presented in English, and a typewritten double space copy in duplicate sent to the Secretary, John C. McClintock, M.D., 149½ Washington Avenue, Albany, New York, not later than January 15, 1955. The committee, who will review the manuscripts, is composed of men well qualified to judge the merits of the competing essays.

A place will be reserved on the program of the annual meeting for the presentation of the Prize Award Essay by the author, if it is possible for him to attend. The essay will be presented in the annual proceedings of the Association.

John C. McClintock, M.D.
Secretary

GRANTS FOR SCHOLARS IN CANCER RESEARCH

Applications for grants for Scholars in Cancer Research are being accepted by the Committee on Growth of the National Research Council, acting for the American Cancer Society.

These awards are designed to bridge the gap between the completion of fellowship training and the period when the young scientist has thoroughly demonstrated his competence as an independent investigator. A grant of $18,000, payable over three years, will be made to each Scholar's institution as a contribution toward his support, his research or both. Each institution may submit more than one application. These grants are not restricted to the support of individuals who have held American Cancer Society Fellowships. Applications should be submitted by institutions on behalf of a candidate prior to January 1, 1955.

Application blanks and additional information may be obtained from the Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, N.W., Washington 25, D. C.

A CORRECTION

An article entitled "Film Dosimetry of Electrons in the Energy Range 0.5 to 1.4 Mev." by Jerome Fleeman and F. S. Frantz, Jr. appeared in the Journal, June, 1954, *71*, 1049–1055. In this paper it was indicated in a footnote on page 1049 that the DuPont film type 552 single film packet was no longer available. The DuPont film type 552 single film packet should not be confused with DuPont type 552 double film packet. The latter contains one type 502 and one type 510 film and is still available.

ARKANSAS RADIOLOGICAL SOCIETY

The Arkansas Radiological Society met in regular session at 6:30 P.M. Friday, June 25, 1954, at Little Rock, Arkansas. A social period and dinner were enjoyed before the meeting. A business session was followed by a stimulating film reading sesssion, moderated by Dr. I. Meschan of Little Rock. New officers for the year 1954–1955 were elected as follows: *President*, Dr. George Burton, El Dorado, Arkansas; *Vice President*, Dr. Edwin F. Gray, Little Rock, Arkansas; *Secretary-Treasurer*, Dr. Joe A. Norton, 843 Donaghey Building, Little Rock, Arkansas.

CHICAGO ROENTGEN SOCIETY

The newly elected officers of the Chicago Roentgen Society for the period April, 1954 to April, 1956, are as follows: *President*, Dr. Elbert K. Lewis; *Vice President*, Dr. Erich Uhlmann; *Secretary-Treasurer*, Dr. R. Burns Lewis, 670 N. Michigan Avenue, Chicago 11, Illinois.

MINNESOTA RADIOLOGICAL SOCIETY

At a recent meeting of the Minnesota Radiological Society, the following officers were elected for 1954–1955: *President*, Dr. Chauncey N. Borman, Minneapolis; *Vice President*, Dr. Harold O. Peterson, St. Paul; *Secretary-Treasurer*, Dr. John R. Hodgson, Mayo Clinic, Rochester, Minnesota.

NASSAU RADIOLOGICAL SOCIETY

The newly elected officers of the Nassau Radiological Society for the year 1954–1955 are as follows: *President*, Dr. Samuel Herstone, Bay Shore, N. Y.; *Vice President*, Dr. Herbert Zatzkin, Hempstead, New York; *Secretary*, Dr. Alan E. Baum, 115 Newbridge Road, Hicksville, New York; *Treasurer*, Dr. John Knapp, Freeport, N. Y.

PHILADELPHIA ROENTGEN RAY SOCIETY

At the May, 1954, meeting of the Philadelphia Roentgen Ray Society, the following

officers were elected for the year 1954–1955: *President*, Dr. Richard H. Chamberlain; *Vice President*, Dr. Marston T. Woodruff; *Secretary*, Dr. Herbert M. Stauffer, Temple University Hospital; *Treasurer*, Dr. Alan Sampson.

RADIOLOGICAL SOCIETY OF HAWAII

At the July, 1954, meeting of the Radiological Society of Hawaii, the following officers were elected to serve until June 30, 1955: *President*, Dr. Peter J. Washko; *Vice President*, Dr. Philip S. Arthur; *Secretary-Treasurer*, Dr. H. C. Chang, 1282 Emma Street, Honolulu 13, Hawaii. Meetings are held the third Monday evening of each month at designated hospitals.

TENNESSEE RADIOLOGICAL SOCIETY

The newly elected officers of the Tennessee Radiological Society for 1954–1955 are as follows: *President*, Dr. J. Marsh Frere, Chattanooga, Tennessee; *Vice President*, Dr. John M. Wilson, Memphis, Tennessee; *Secretary-Treasurer*, Dr. George K. Henshall, 311 Medical Arts Building, Chattanooga 3, Tennessee. The meeting at which the officers were elected was held in conjunction with the State Medical Association Meeting in Nashville, Tennessee on April 19, 1954. The guest speaker, Dr. C. A. Good of the Mayo Clinic, Rochester, Minnesota, chose as his subject "Fungus Diseases of the Chest."

BOOK REVIEWS

Books sent for review are acknowledged under: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers as space permits.

ROENTGENOLOGY IN OBSTETRICS AND GYNECOLOGY. By William Snow, M.D., Chief Radiologist, Veterans Hospital; Consulting Radiologist, Willis-Knighton Memorial Hospital and Clinic, Shreveport, Louisiana; Formerly Director of Roentgenology, The Harlem Hospital, The Bronx Hospital, New York, New York. Cloth. Price, $10.50. Pp. 363, with 273 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1952.

Since 1942 Dr. Snow's original book entitled "Clinical Roentgenology of Pregnancy" has become the foundation upon which much of the current literature dealing with pelvimetry is based.

This new edition of his work does not alter his basic concept and, while refinements in technique and diagnosis are evident in the new, enlarged and more comprehensive volume, the fundamental simplicity of his teachings is retained, making this an extremely practical volume for the radiologist and an excellent text for the postgraduate student in either obstetrics or radiology.

The wide scope of this new edition presents clinical material covering the entire field of obstetrical and gynecological roentgen studies equivalent to many years of practical experience. It stresses fetal and maternal soft tissue and gynecological examinations, in addition to the popular methods of pelvimetry, and correlates pelvic measurements and contours with fetal position. It enables the radiologist to determine the probable mechanism of labor, when pelvic measurements are abnormal or when an abnormal fetal position is encountered and thereby intelligently aid the obstetrician.

The text is fully illustrated with tracings to supplement some of the illustrations. It is easily read and understood. Those who have had considerable experience in this field may not fully agree with all portions of the text but this is primarily due to the controversial nature of some of the material. With modern equipment and technique the quality of the films used for illustrating various cases might be improved but the reviewer realizes that many years' work has been accumulated to make this the outstanding book in this field.

K. K. LATTEIER, M.D.

SECTIONAL RADIOGRAPHY OF THE CHEST. By Irving J. Kane, M.D., Consultant in Chest Diseases, United States Naval Hospital, St. Albans, N. Y.; Attending Physician, Chest Diseases, Lincoln Hospital, New York, N. Y.; Associate Physician, Diagnostic Roentgenology, Montefiore Hospital, New York, N. Y. Cloth. Price, $7.50. Pp. 154, with 101 illustrations. Springer Publishing Company, Inc., 44 East 23rd Street, New York 10, New York, 1953.

This attractive little volume represents a brief introduction to the subject. Thirty-four pages of text concerned with theoretical, practical, and anatomical fundamentals are followed by approximately 100 pages of illustrations and legends. The material presented is not controversial and will be familiar to most radiologists. A summary of the common pitfalls in the interpretation of sectional roentgenograms of the chest would have been a worthwhile addition to the coverage.

From the point of view of book design, this volume represents a decisive step forward. The front cover design—a lateral laminagram of the chest—artistically indicates the nature of the work, and is a welcome relief from the stereotyped, dull bindings so standard in medical texts. The illustrations are generous in size, well made, and appropriately reproduced without the customary useless unattractive and uneconomical wide white margins. The progressive publisher has done an excellent job of production for the author in particular, and for radiologists in general.

CHARLES T. DOTTER, M.D.

DER GESUNDE UND DER KRANKE KEHLKOPF IM RÖNTGENBILD. Von Prof. Dr. Med. C. R. Griebel, Bad Nauheim. Cloth. Price, DM 48.-. Pp. 170, with 156 illustrations. Georg Thieme, Diemershaldenstrasse, 47, Stuttgart, Germany (Grune & Stratton, Inc., New York, New York), 1952.

This beautifully printed roentgen atlas is

some of the fruit of the large clinical material of the Frankfurt Nose, Throat and Ear Clinic. The illustrations are beautifully reproduced—typical roentgenograms of normal and disease conditions in this region. The fact that the illustrations are printed in the "black" instead of in the "negative" like the original films means that more detail has been preserved in the printed illustrations. Any competent radiologist, of course, can read the films in the negative or in the positive. It is our frank opinion that the original detail is better preserved in the positive than in the negative roentgenograms. To further aid the reader, explanatory drawings are presented side by side with the reproductions of the roentgenograms. The 156 illustrations in this atlas constitute a storehouse of precious clinical material. The German text is not too difficult.

James T. Case, M.D.

Malignant Disease and Its Treatment by Radium. By Sir Stanford Cade, K.B.E., C.B., F.R.C.S., M.R.C.P., F.F.R. (Hon.), Surgeon, Westminster Hospital; Consulting Surgeon, Mount Vernon Hospital and Radium Institute; etc. With a Foreword by Sir Ernest Rock Carling, F.R.C.P., F.R.C.S., F.F.R., Consulting Surgeon and Vice-President, Westminster Hospital. Volume IV. Second edition. Cloth. Price, $12.50. Pp. 544, with 785 illustrations. The Williams & Wilkins Company, Mt. Royal and Guilford Avenues, Baltimore, Maryland, 1952.

The second edition of Volume IV contains sections dealing with malignant disease of the skin and genitourinary tract and sarcoma of the bones and soft tissue by Stanford Cade; Tumors of lymphoid tissue by George Lumb and F. M. Allchin; The Leukemias by B. W. Windeyer and F. W. Stewart, and Intracranial Tumors by Denis Williams, Wylie Mckissock and J. Jackson Richmond. Each section covers the clinical course, signs and symptoms and pathology of the disease under consideration as well as the choice of treatment and results. Although the book is small it contains 785 excellent illustrations some of which are printed in color. A complete bibliography is included and a large number of references are taken from the American literature. This is an unusual and encouraging feature rarely found in a book written in another country.

During the era when radium therapy seems to be falling into disrepute this treatise which summarizes the results obtained by physicians who are expert in its use is of unusual interest. Roentgen therapy and surgical procedures are also evaluated but the uses of radium are fully described and its advantages are stressed. Techniques of using interstitial low intensity needles, surface applicators and the radium bomb are included.

Many illustrative case histories are given in detail and the palliative effect of irradiation is emphasized. The authors are convinced that it may even be used to advantage in the treatment of such resistant neoplasms as the melanomas, brain tumors and sarcomas of bone and the soft tissues.

This compact volume built about the actual experience of a well trained personnel and containing such well documented information collected over a long period of time will make a valuable addition to any radiotherapist's library.

Charles L. Martin, M.D.

The Physician in Atomic Defense. By Thad P. Sears, M.D., F.A.C.P., Associate Clinical Professor of Medicine, University of Colorado School of Medicine; Chief of Medical Service, Veterans Administration Hospital, Denver; Member of Advisory Staff to Director of Civil Defense, State of Colorado; Member of Disaster Commission, Colorado State Medical Society; Colonel (M.C.), U.S.A.R. Cloth. Price, $6.00. Pp. 308, with illustrations. Year Book Publishers, Inc., 200 E. Illinois Street, Chicago 11, Illinois, 1953.

This book merits careful perusal by all of those who wish to become familiar with the fundamental facts concerning radioactivity, and especially its civil and military implications. It is a relatively simple, authoritative presentation of vital information which is concerned with medical, industrial and defense matters.

The book is well written and easily read. It is properly indexed and supplied with an adequate bibliography for additional reading. An idea of its contents may be gained from the introduction which is concerned with the historical background of the Atomic Theory, and the remaining three sections which deal with the following data: Section I. Atomic Theory, Basic Physics and Atomic Bombs; Section II. Clinical, Biological, Pathologic and Thera-

peutic Aspects of Atomic Warfare; Section III. Organization of the Medical Department for Atomic Defense.

Obviously Dr. Sears, the author, is an enthusiastic advocate of civil defense. In the opinion of the reviewer, his attitude is justified by the material presented in the book. To those who are unconcerned, let them ponder over the following facts presented by the author. He maintains that the United States has ample industrial power to defeat any enemy ultimately. Hence, undoubtedly, immediate destruction of this productivity would be the obvious main objective of a military attack. The simultaneous destruction of a dozen or more industrial centers with disruption of rail and water transportation would thus at once impair seriously our ability to defend ourselves or carry on a campaign on foreign shores. Such an attack on densely populated areas would certainly kill or injure millions of our citizens. Some idea of what might occur may be gained by the information derived from the Hiroshima and Nagasaki bombings, involving a total population of 500,000 persons. Of these, 216,000 were killed, missing or injured, and of these 106,000 died. In addition, each of these bombs which exploded with a force of 20,000 tons of TNT caused the destruction of 68,000 of the 75,000 homes in Hiroshima, disrupted communications, transportation, water supply, electric distribution, destroyed hospitals, and killed many physicians and nurses.

The last section of the book is devoted to a discussion of the organization of a medical department for Atomic defense. It contains chapters dealing with Civil Defense, Organization of Non-medical Civil Defense Measures, the Medical Services and Blood Program, the Public Health Mission, and Radiologic Defense.

The book brings up unpleasant but pressing facts which cannot be ignored. They should stimulate us to follow the age old advice, "Be prepared fully for the worst and hope for the best."

Cyrus C. Sturgis, M.D.

Radiation Chemistry. Discussions of the Faraday Society. No. 12, 1952. Cloth. Pp. 319. The Aberdeen University Press Ltd. 6 Upper Kirkgate, Aberdeen, 1952.

This volume is a record of the meeting held on the subject of Radiation Chemistry at the University of Leeds on the 8th, 9th and 10th of April, 1952.

This collection of 22 papers is divided in four parts, preceded by a scholarly introduction by Professor F. S. Dainton and each followed by general discussion on the part of the audience.

The topics treated are specifically: I. The primary act along the track of the ionizing particle, II. Actinometry and radiolysis of pure liquids, III. Indirect action-aqueous systems with single solute, IV. Protection and sensitization.

Since the author index is a veritable "Who's Who" in radiation chemistry, there can be little doubt that the subject has been competently covered; in addition, your reviewer has found many papers uncommonly lucid and very instructive despite the necessary emphasis of the essayists on experimental details. After reading this book one cannot escape the impression that the radiolysis of water is under relentless scrutiny which will soon uncover its details.

The book, as a whole, does not make for easy reading and, like good coffee, should be sipped at ease by the nonspecialist interested in radiobiology. It should prove helpful to inorganic and organic chemists and biochemists interested in this rapidly growing field.

L. D. Marinelli

Annual Review of Medicine. Volume 4. Windsor C. Cutting, Editor, Stanford University School of Medicine; and Henry W. Newman, Associate Editor, Stanford University School of Medicine. Cloth. Price, $6.00. Pp. 452, Annual Reviews, Inc., Stanford, California, 1953.

One of the most important problems in present-day medicine is keeping abreast of the extensive and useful information contained in the many current medical publications. It is admittedly impossible for any one physician to read all of the published medical articles. Even if this could be accomplished, it is not likely that any one person could evaluate them properly in every field. Hence, a publication such as the *Annual Review of Medicine* is of assistance in solving, at least in part, this difficult situation.

The reviews in this volume are comprehensive and prepared by authorities in their respective fields. In the 19 reviews contained in the 1953 volume are also included, in addition to the usual subjects considered to be a part of internal medicine, reviews dealing with neoplastic diseases, diseases of the female reproductive system, conditions due to physical

agents and trauma such as burns and freezing, radiology, diseases of the bones and joints, obstetrics, tropical diseases, and plastic surgery.

There is a bibliography appended to each subject reviewed, and also an excellent "Annotated List of Reviews in Medicine," prepared by Eaton M. MacKay which lists many review articles with brief comments concerning their extent and value. This is an excellent source of information dealing with additional references which should be useful to anyone interested in a special subject.

The volume is recommended to all physicians as a valuable, carefully prepared and comprehensive source of information in the many fields of medicine which are considered.

Cyrus C. Sturgis, M.D.

BOOKS RECEIVED

Clinical Roentgenology. Volume I. By Alfred A. de Lorimier, M.D., Radiologist, Saint Francis Memorial Hospital, San Francisco, California; Henry G. Moehring, M.D., Radiologist, Duluth Clinic, Duluth, Minnesota; John R. Hannan, M.D., Radiologist, Lake County Memorial Hospital, Painesville, Ohio. Cloth. Price, $18.50. Pp. 495, with 782 illustrations. Charles C Thomas, Publisher, 301 East Lawrence Avenue, Springfield, Illinois, 1953.

Symposium on Coal Miners' Pneumoconiosis. Held Under the Auspices of The Golden Clinic, Memorial General Hospital, Elkins, West Virginia. Paper. Pp. 95. The Golden Clinic, Memorial General Hospital, Elkins, West Virginia, 1952.

Die Lungenresektionen. Von Prof. Dr. A. Lezius, O. O. Professor der Chirurgie an der Universität Hamburg, Direktor der Chirurgischen Universitätsklinik und Poliklinik Hamburg-Eppendorf; mit einem geleitwort von Prof. Dr. R. Nissen, Direktor der Chirurgischen Universitätsklinik, Basel. Cloth. Price, DM 49.80. Pp. 143, with 149 illustrations. Georg Thieme, Diemershaldenstrasse 47, Stuttgart, Germany, 1953.

Röntgen-Grobstrukturen des Thorax. Von Dr. med. Heinrich Eschbach, Leiter der Röntgenabteilung der Poliklinik Stralsund. Cloth. Price, DM 30,—. Pp. 270, with 237 illustrations. Georg Thieme, Thomaskirchhof 21, Leipzig C. 1, Germany (Paul B. Hoeber, Inc., New York, New York), 1953.

Fundamentals of Clinical Orthopedics. By Peter A. Casagrande, M.D., Orthopedic Department of Buffalo General Hospital, Buffalo Children's Hospital, and the University of Buffalo Medical School; Attending Orthopedist at the Chronic Disease Research Institute of the University of Buffalo, and the Veterans Administration Hospital, Buffalo, New York; and Harold M. Frost, Jr., M.D., Orthopedic Department of Buffalo General Hospital and the University of Buffalo Medical School, Buffalo, New York. Cloth. Price $18.50. Pp. 582, with numerous illustrations. Grune & Stratton, Inc., 381 Fourth Avenue, New York 16, New York, 1953.

Die Gesunde und die Kranke Wirbelsäule in Röntgenbild und Klinik. Pathologisch-Anatomische Untersuchungen. Von Geh. Med.-Rat Prof. Dr. med. et Dr. med. vet. h.c. Georg Schmorl; Für Röntgenkunde und Klinik Bearbeitet. von Prof. Dr. med. habil. Herbert Junghanns, Oldenburg (Oldb.). Copyright 1932, 1953. Cloth. Price, DM 72. Pp. 304, with 403 illustrations. Georg Thieme, Diemershaldenstrasse 47, Stuttgart, Germany, 1953

Shoulder Lesions. By H. F. Moseley, M.A., D.M., M.Ch. (Oxon.), F.R.C.S. (England & Canada), F.A.C.S., Hunterian Professor, Royal College of Surgeons of England; Assistant Professor of Surgery, McGill University; Associate Surgeon, Royal Victoria Hospital, Montreal, Canada. Second edition. Cloth. Price, $12.00. Pp. 329, with numerous illustrations. Paul B. Hoeber, Inc., 49 East 33rd Street, New York, New York, 1953.

Osteosklerose und Knochenmarkfibrose. Von Rudolph Stodtmeister, Dr. med. Dr. phil., apl. Professor für innere Medizin an der Universität Heidelberg. Chefarzt der Inneren Abteilung des Städtischen Krankenhauses Pforzheim; und Stefan Sandkühler, Dr. med., Assistent der Ludolf-Krehl-Klinik (Medizin, Univ.-Klinik) Heidelberg; unter röntgenologischer Mitarbeit von Albert Laur, Dr. med., Assistent der Röntgenabteilung der Ludolf-Krehl-Klinik (Medizin, Univ.-Klinik) Heidelberg. Cloth. Price, DM 28.50. Pp. 135, with 29 illustrations. Georg Thieme, Diemershaldenstrasse 47, Stuttgart, Germany, 1953.

Peripheral Nerve Injuries; Principles of Diagnosis. By Webb Haymaker, M.D., Chief, Neuropathology Section, Armed Forces Institute of Pathology, Washington, D. C.; and Barnes Woodhall, M.D., Professor of Neurosurgery, Duke University School of Medicine, Durham, North Carolina. Second edition. Cloth. Price, $7.00. Pp. 333, with 272 illustrations. W. B. Saunders Company, West Washington Square, Philadelphia 5, Pennsylvania, 1953.

Obecná Neuroradiologie. By Doc. Dr. Jan. Jirout. Stiff paper. Pp. 274, with 247 illustrations plus 347 figures in separate booklet. Státní Zdravotnické Nakladatelství, Praha, Czechoslovakia, 1953.

Practical X-Ray Treatment. By Arthur W. Erskine, M.D. Fourth edition. Cloth. Price, $5.00. Pp. 195, with 20 illustrations. Bruce Publishing Co., 2642 University Avenue, St. Paul 14, Minnesota, 1953.

Tumors of the Male Sex Organs. By Frank J. Dixon, M.D., Professor of Pathology, University of Pittsburgh School of Medicine, Pittsburgh, Pennsylvania; and Robert A. Moore, M.D., Professor of Pathology, Washington University School of Medicine, St. Louis, Missouri. Paper. Price, $1.50. Pp. 179, with 135 illustrations. Armed Forces Institute of Pathology, Washington 25, D. C., 1952.

Third Annual Report on Stress. By Hans Selye, M.D., Ph.D. (Prague), D.Sc. (McGill), F.R.S. (Canada), Professor and Director of the Institut de Médecine et de Chirurgie expérimentales, Université de Montréal; and Alexander Horava, M.D. (Lausanne), Research Associate and Librarian of the Institut de Médecine et de Chirurgie expérimentales, Université de Montréal. Cloth. Pp. 637, with illustrations. Acta, Inc., 5465 Decarie Boulevard, Montreal 29, Quebec, Canada, 1953.

Nuclear Moments. By Norman F. Ramsey, Professor of Physics, Harvard University. Cloth. Price, $5.00. Pp. 169, with 38 illustrations. John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, New York, 1953.

Annual Review of Nuclear Science. Volume 2. J. G. Beckerley, Editor. Cloth. Price, $6.00. Pp. 429, with numerous illustrations. Annual Reviews, Inc., Stanford, California, 1953.

Annual Review of Nuclear Science. Volume 3. J. G. Beckerley, Editor. Cloth. Price, $7.00. Pp. 412, with numerous illustrations. Annual Reviews, Inc., Stanford, California, 1953.

Fourteenth Semiannual Report of the Atomic Energy Commission. By United States Atomic Energy Commission, Gordon Dean, Chairman. Paper. Pp. 98, with tables. United States Government Printing Office, Washington, D. C., 1953.

Ninth Annual Report to the Honourable the Minister for Health and Home Affairs. For the Year Ended 30th June, 1953. Presented to Parliament and Ordered to be Printed. Paper. Pp. 22, with numerous tables. A. H. Tucker, Government Printer, Brisbane, 1953.

Vol. 72, No. 4

ABSTRACTS OF RADIOLOGICAL LITERATURE

Department Editor: T. Leucutia, M.D., Harper Hospital, Detroit 1, Michigan

INDEX TO ABSTRACTS

ROENTGEN DIAGNOSIS

Head

Rabaiotti, A.: Anatomo-laminagraphic demonstration of a portion of the base of the skull with transbuccal incidence of the normal ray 692
Bruwer, A., Holman, C. B., and Kierland, R. R.: The roentgenologic recognition of cutis verticis gyrata 692
Gicovate, Fanny: Observations on twelve cases of hyperostosis frontalis interna 692
Melot, G. J., and Potvliege, R.: Cerebral atrophy 692
Stern, W. E.: Studies of pressures in the carotid artery of patients undergoing cerebral angiography 693
Wickbom, I.: Angiographic determination of tumour pathology 693
Seaman, W. B., and Schwartz, H. G.: Cerebral arteriography with sodium acetrizoate (urokon sodium) 30% 693
Masy, S., and Grégoire, A.: Cisternography. 694

Neck and Chest

Dazzi, C.: Hypertrophy of the tonsils and mediastinal hilar adenopathy 694
Dancot, H.: Cylindromas of the salivary glands; a study of 19 cases 695
Warren, S., Alvizouri, M., and Colcock, B. P.: Carcinoma of the thyroid in childhood and adolescence 695
Littleton, J. T., Motsay, D. S., and Perry, S. P.: Thymus problem 696
Reinhardt, K.: An iodized oil-sulfonamide powder mixture as bronchographic contrast material 696
Forsee, J. H., Farinacci, C. J., and Blake, H. A.: Ectopia of primary thymic tumors ... 696
Robert, F., Riberi, A., and Testini, A.: On the technique of double contrast media in the roentgen examination of the esophagus 696
Kirchhoff, H. W.: Differential diagnosis of the changes of the mediastinum in early infancy 697
Sloan, R. D., and Cooley, R. N.: Coarctation of the aorta; the roentgenologic aspects of one hundred and twenty-five surgically confirmed cases 697
Jönsson, G., Brodén, B., and Karnell, J.: Angiocardiographic demonstration of pulmonary stenosis 698
Cooper, G., Jr., Birdsong, McL., and Bradshaw, R.: Emergencies in the newborn 698
Volbeding, K. H., and Repkewitz, R.: On roentgen findings in poliomyelitis with special emphasis on pulmonary changes 698
Gombert, H. J.: Rare causes and types of intermittent and constant atelectasis 698
Katz, S., *et al.*: Bronchography with a water-soluble contrast medium (umbradil) 699
Miceli, R.: Polycystic bronchiectatic lung; roentgenological contribution 699
Roswit, B., Kaplan, G., and Jacobson, H. G.: The superior vena cava obstruction syndrome in bronchogenic carcinoma; pathologic physiology and therapeutic management 699
Mitchell, R. S.: Roentgenographic spreads of pulmonary tuberculosis occurring during sanatorium residence before the use of prolonged chemotherapy 700
Marchal, M.: Cinedensography and the exploration of lung tumors; technique of cinedensography 700
Ravina, A., Marchal, M., and Pestel, M.: Cinedensography and the exploration of lung tumors; application of cinedensography to the study of lung tumors 700
Mannix, E. P., Jr.: Resection of multiple pulmonary metastases fourteen years after amputation for osteochondrogenic sarcoma of tibia; apparent freedom from recurrence two years later 700

Abdomen

Shufflebarger, H. E., *et al.*: Some factors influencing the roentgen visualization of the mucosal pattern of the gastrointestinal tract 701
Frik, W., and Zeidner, A.: Roentgen examination of the fine gastric mucosal relief. I. The importance of so-called granular gastritis 701
Gomes, F. de A.: Diagnosis and treatment of prolapse of the gastric mucosa 701
Lewitan, A.: Roentgenologic study of Mec-

kel's diverticulum; case report 702
Hodges, P. C.: Roentgen examination of the colon 702
Swenson, P. C., and Jeffrey, R. B.: Limitations in the use of roentgen examination of the gastrointestinal tract 703
Sommer, A. W., and Goodrich, W. A., Jr.: Gastric diverticula 703
Gianturco, C., and Miller, G. A.: Program for the detection of colonic and rectal polyps 704
Golden, R., and Morales, P. L.: Radiological examination in organic diseases of small intestine 704

Gynecology and Obstetrics

Whitehead, A. S.: The determination of the placental site by soft-tissue radiography 704
Neel, J. V., *et al.*: The effect of exposure to the atomic bombs on pregnancy termination in Hiroshima and Nagasaki: preliminary report 706
Borell, U., and Fernström, I.: The adnexal branches of the uterine artery; an arteriographic study in human subjects 706
Granjon, A.: Gynecography 706

Genitourinary System

Duff, J., Kenyon, H. R., and Hyman, R. M.: Pyelography in combination with simultaneous retroperitoneal pneumography 707
Petković, S.: Urography in tumors of the sigmoid colon and rectum penetrating into the bladder 707
Salvati, R.: Intramuscular urography with hyaluronidase; indications and limitations in children 707
Bonetta, C.: Intramuscular urography with hyaluronidase 707
Petkovic, S.: The urographically silent kidney and ureterocolostomy 708
Boyce, W. H., Harris, J. A., and Vest, S. A.: The dorsal cystogram or "squat shot:" a technique for roentgenography of posterior bladder and pelvic ureters 708
Forbes, K. A., and Cordonnier, J. J.: Circulatory collapse following combined use of Rayopake and air for urethrocystography .. 709
Higgins, C. C.: Nonopaque urinary tract calculi 709
Presman, D.: The symptomatology and management of prostatic calculi 709
Garrett, R. A., and Mertz, H. O.: Wilms's tumor in children 710
Krieger, H., *et al.*: Bilateral total adrenalectomy in patients with metastatic carcinoma 710

Nervous System

Svien, H. J., Price, R. D., and Bayrd, E. D.: Neurosurgical treatment of compression of the spinal cord caused by myeloma 710
Wycis, H. T.: Lipoma of the spinal cord associated with Klippel-Feil syndrome 710

Skeletal System

Mitchell, J.: Cough fracture 710
Shapiro, R. D., Bernstein, W. H., and Berman, T. M.: Melorheostosis Léri; report of a case and a brief review of literature 711
Liess, G., and Dörffel, E.: Roentgen study about the bony structures in Albers-Schönberg disease 711
Kastert, J.: Roentgen diagnosis of the osseous tuberculous focus; evaluation of the older and newer methods of examination 711
Miall, W. E., *et al.*: An epidemiological study of rheumatoid arthritis associated with characteristic chest x-ray appearances in coal-workers 711
Broder, H.: The late results in Legg-Perthes' disease and factors influencing them: a study of one hundred and two cases 712
Milch, H.: Ischial apophysiolysis: a new syndrome 712
Landoff, G. -A.: Vertebral fractures in insured and uninsured patients; analysis of the frequency and duration of symptoms, convalescence and disability 713
Vilaseca, J. M., Barceló, P., and Casademont, M.: Interspinous neoarthrosis 713
Latimer, F. R., Webster, J. E., and Gurdjian, E. S.: Osteitis deformans with spinal cord compression; report of three cases 713
Bürger, M., and Schulze, W.: Alcaptonuric osteoarthropathy and osteoporosis 714
Dent, R. V., *et al.*: Abdominal topography in relation to senile osteoporosis of the spine ... 714
Wilson, D.: A study of spinal osteoporosis 714
Mygind, H. B.: The accessory tarsal scaphoid; clinical features and treatment 714
Trueta, J.: The influence of the blood supply in controlling bone growth 715
Sear, H. R.: The congenital bone dystrophies and their co-relation 716
Lichtenstein, L.: Aneurysmal bone cyst; further observations 717
Holt, J. F.: Unusual "bone tumors" in infants and children 718

Blood and Lymph System

Cooper, D. R., *et al.*: Splenoportography 718
Wyburn-Mason, R.: Costo-clavicular compression of the subclavian vein 719
Stiff, D. W. S., and Powell, G. M.: Roentgenologic observations in hemorrhagic fever. 719
Custer, R. P.: Borderlands dim in malignant disease of the blood-forming organs 719
Petković, S.: Demonstration of the pelvic veins by various methods 720

Rabaiotti, A.: Venous changes in thrombosis of the lower extremity and pelvis with application of various methods of phlebography 720
Boyd, A. M., *et al.*: The technic and interpretation of lower limb phlebography 721

General

Umiker, W., and Jaffe, H. L.: Ossifying fibrosarcoma (extraskeletal osteogenic sarcoma) of thigh muscle; report of a case with recurrence and widespread metastases more than four and a half years after excision 721

RADIATION THERAPY

Spina, V., Raia, R., and Reginato, L. E.: Treatment of keloids 722
Wynne, E. S., *et al.*: Response of irradiated cancer patients to Vibrio metschnikovii 722
Beierwaltes, W. H.: X-ray treatment of malignant exophthalmos: a report on 28 patients 722
Adams, H. D., *et al.*: The treatment of carcinoma of the esophagus and cardia by resection and postoperative supervoltage roentgen rays 723
Smith, G. V., and Smith, Olive W.: Carcinoma of the breast; results, evaluation of x-radiation, and relation of age and surgical castration to length of survival 723
Morgan, R. H.: Protection from roentgen rays 724
Schulz, M. D., and Stetson, C. G.: Radiation therapy of malignant lesions about the eye. 724
Wildermuth, O., and Cantril, S. T.: Radiation necrosis of the mandible 725
Walker, J. H., and Jones, H. W.: The irradiation management of primary round-cell tumors of bone 726
Harmer, W. D.: Treatment of cancer of the larynx by interstitial radium needles 726
Finney, R.: Dupuytren's contracture; a radiotherapeutic approach 726
Levitt, W. M.: Radiotherapy in the prevention and treatment of hypertrophic scars 726
Glücksmann, A.: Local factors in the histogenesis of hypertrophic scars 727
Fried, C.: Roentgen irradiation of thromboangiitis obliterans and related arterial disturbances 728
Kaplan, I. I.: A study of effects of x-rays on the grandchildren of women who have been irradiated for the treatment of female sterility 728
Böhmer, E., and Heite, H. J.: The influence of radiation therapy on the longevity of patients with mycosis fungoides 728
Zuppinger, A.: Irradiation and the vegetative nervous system 729
Birkner, R., and Trautmann, J.: The dependence of psychologic, sleep, and sexual functions on the vegetative centers in the hypothalamus and alterations of these functions by roentgen irradiation with small doses to the midbrain 729

RADIOISOTOPES

Brucer, M., Andrews, G. A., and Bruner, H. D.: A study of gallium^{72}; summary and conclusions 729
Brucer, M., and Brunner, H. D.: A study of gallium^{72}. I. Physics and radiation characteristics of gallium^{72} 729
Perkinson, J. D., Jr., Eldridge, J. S., and Cooper, Betty M.: A study of gallium^{72}. II. Gallium chemistry of biological interest .. 730
Perkinson, J. D., Jr., and Ingols, R. S.: A study of gallium^{72}. III. Effect of internal irradiation on respiration of rat liver slices ... 730
Bruner, H. D., Cooper, Betty M., and Rehbock, D. J.: A study of gallium^{72}. IV. Toxicity of gallium citrate in dogs and rats .. 730
Bruner, H. D., *et al.*: A study of gallium^{72}. V. Distribution studies on gallium^{72} in rats 730
Andrews, G. A., Root, S. W., and Kerman, H. D.: A study of gallium^{72}. VI. Clinical studies with gallium^{72} 730
Bruner, H. D., *et al.*: A study of gallium^{72}. VII. Studies of the urinary excretion of gallium^{72} in man 731
Brucer, M., *et al.*: A study of gallium^{72}. VIII. Autopsy studies of distribution of gallium^{72} 731
Gallimore, J. C., Jr., *et al.*: A study of gallium^{72}. IX. Autoradiographic studies 731
Bruner, H. D., Hayes, R. L., and Perkinson, J. D., Jr.: A study of gallium^{72}. X. Preliminary data on gallium^{67} 731
Spalding, C. K., Deamicis, E., and Cowing, R. F.: Radiation exposure survey of x-ray and isotope personnel 731
Grosch, D. S., and Sullivan, R. L.: The fate of radiophosphorus ingested by Habrobracon females 732
Rawson, R. W., Rall, J. E., and Robbins, J.: Uses and misuses of radioactive iodine in treatment of cancer of thyroid 732

ROENTGEN DIAGNOSIS

Head

Rabaiotti, Antonio. Rilievi anatomo-stratigrafici di una porzione della base cranica con incidenza transbuccale del raggio normale. (Anatomo-laminagraphic demonstration of a portion of the base of the skull with transbuccal incidence of the normal ray.) *Ann. radiol. diag.*, 1953, *26*, 258–277.

The author utilized transverse axial laminagraphy to study the structures of the base of the middle fossa of the skull. The central ray was aimed at the level of the palate with 35 degree deflection of the skull between the external acoustic meatus and the external angle of the orbit. Exposures were made at 9 cm. and at levels of 0.5 cm. up to 12.5 cm.—a thickness which includes all the bony structures located in this area.

By using this method all foramina of the middle fossa of the skull including the components of the petrous pyramids, such as the semicircular canals, cochlea, internal and external auditory canals and middle ear were visualized.

This is a splendid anatomical demonstration showing that details of this part of the skull can be studied roentgenographically. The illustrations which accompany the article are excellent, although the investigations were performed on a dry skull specimen. Since this portion of the skull is so important in otoneurological diseases, better visualization of these structures would appreciably increase the diagnostic value of alterations taking place before considerable progress of the disease has occurred.—*Peter E. Russo, M.D.*

Bruwer, André, Holman, Colin B., and Kierland, Robert R. The roentgenologic recognition of cutis verticis gyrata. *Proc. Staff Meet., Mayo Clin.*, Nov. 4, 1953, *28*, 631–635.

In this condition the scalp is thick, is thrown into folds and feels soft and oily. These folds are more marked in the vertex, where they run anteroposteriorly, and in the occiput, where they run transversely.

Almost 50 per cent of the cases are developmental or primary, unassociated with any other condition. The other half are due to acute or chronic inflammatory changes in the scalp, neurofibroma or associated with diseases in which proliferative skin changes are common. The lesion produces no symptoms. The simplest method of diagnosis is inspection and palpation, which is often omitted in the physical examination. The condition is clearly demonstrated in the roentgenograms of the skull as wavy soft tissue shadows, unassociated with changes in the calvarium.—*Martha Mottram, M.D.*

Gicovate, Fanny. Observaciones sobre 12 casos de hiperostosis frontal interna. (Observations on twelve cases of hyperostosis frontalis interna.) *Semana méd.*, Dec. 31, 1953, *103*, 975–986.

A brief review of the literature, the clinical picture and the roentgen findings of hyperostosis frontalis interna is given. The data on 12 cases collected in the author's experience are presented. The majority of the patients were women of the menopausal age, with a definite tendency toward obesity, and headache. No hereditary tendencies were noted. About 25 per cent exhibited some psychopathic manifestation and another 25 per cent showed evidence of acromegaly or probable tumor of the pituitary.—*Charles Nice, M.D.*

Melot, G. J., and Potvliege, R. Les atrophie cérébrales. (Cerebral atrophy.) *J. belge de radiol.*, 1953, *36*, 389–408.

The term of "cerebral atrophy" is applied, in the literature, to all types of deficiencies of cerebral tissue, such as agenesis, hypoplasia and also to those resulting from infection, injury or vascular abnormality. A correct diagnosis can frequently be made without use of contrast studies, by standard roentgenography and laminagraphy of the skull, by observing the size of a cranial cavity on one or the other side; inclination of the crista galli; size of the frontal, ethmoidal or sphenoidal sinuses; elevation of the lateral sinus, etc. In infants cerebral atrophy may be diagnosed by the lateral displacement of the fontanelle, even before pneumatization of the frontal sinus has taken place. However, while it is possible frequently to make a diagnosis by such means, the authors do not imply that complete dependence should be placed on these methods and they urge the use of electroencephalography and double contrast methods of examination.

They report 2 cases in which it was possible to make a correct diagnosis by correlation of the clinical features with the findings on skull roentgenography without contrast study. Six cases in which electroencephalography or ventriculography was employed are used to illustrate the aspects of air contrast examination in cases of obstetrical trauma and war injuries to the skull, in patients having a history of epilepsy.

Cerebral atrophy may be primary, such as one encounters in agenesis, aplasia and hypoplasia. Secondary cerebral atrophies are due to trauma; infection (encephalitis, meningitis, syphilis); circulatory derangement (anemias, intoxication, cardiac disease); or may be the result of local arteriosclerosis. Possibilities of hemorrhage, thrombosis, embolism, arteriovenous aneurysms as well as systemic atrophies of unknown origin associated with such conditions as Pick's disease or Alzheimer's disease are also encountered.

This is a careful review of the findings in cerebral atrophy, is well documented and the illustrations are excellent and reproduced clearly.—*Angus K. Wilson*, M.D.

Stern, W. Eugene. Studies of pressures in the carotid artery of patients undergoing cerebral angiography. *J. Neurosurg.*, Nov., 1953, *10*, 577–582.

Successful treatment of intracranial arterial lesions depends on adequate collateral circulation following occlusion of major arterial channels.

The author has studied intracarotid pressures and related them to angiographic filling of the circle of Willis after unilateral and bilateral occlusion of the common carotid arteries in an attempt to prognosticate the subsequent pattern of circulation. His series consisted of 10 patients suffering from various neurologic disturbances. An 18 gauge needle was placed in the exposed artery and continuous pressures recorded before and during ipsilateral and bilateral common carotid occlusion. Subsequent bilateral angiography was done with 35 per cent diodrast.

The studies failed to reveal any correlation between the amount of pressure fall after ipsilateral and bilateral common carotid occlusion and the presence or absence of bilateral filling of the anterior or posterior halves of the circle of Willis. The only exception to this was the finding of high residual systolic and diastolic pressures (above 60 and 75 per cent of original reading respectively) following unilateral occlusion and the presence of bilateral filling of the anterior cerebral arteries.—*Geno Di Bagno, M.D.*

Wickbom, Ingmar. Angiographic determination of tumour pathology. *Acta radiol.*, Dec., 1953, *40*, 529–546.

More than 500 intracranial neoplasms were studied by cerebral angiography at the Serafimer Hospital. The types found most frequently supplied with pathologic vessels were glioblastomas (243), meningiomas (85), and metastases (40). The author considers that pathognomonic changes occur with glioblastomas and meningiomas, and that the preoperative diagnoses of these conditions may be important because meningiomas are favorable tumors for removal whereas glioblastomas are often impossible to remove.

The glioblastomas were classified into 6 types on the basis of vascular patterns. Type I (74 cases) was characterized by arteriovenous fistulas which show up as irregularly coursing vessels in which the lumens vary in size. Frequently this allowed filling of veins during the arterial phase of the arteriogram. In some cases the medium stagnated in the veins of the tumor; in others it passed through rapidly. Type II (30 cases) showed similar, irregular tumor vessels but no filling of veins to indicate arteriovenous fistulas. In Type III (22 cases) there were also many tumor vessels, but they were shorter and narrower, with aneurysmal dilatations. Type IV (59 cases) was marked by some short, comparatively thin vessels with slightly irregular lumen. In each of the 4 types, instances of hemorrhage and other degenerative changes were encountered which produced nonvascular areas on the arteriograms, surrounded by peripheral, highly vascular zones. In Type V (28 cases) the tumor area was found to be less well vascularized than were the surroundings. In the remaining 30 glioblastomas, representing Type VI, no arteriographic abnormality could be demonstrated.

The author divided meningiomas into five groups. In Group I (24 cases) the tumor appeared as a contrast formation of homogeneous density. The appearance of the tumors varied in many of the cases because of differences in blood supply from the external carotid artery. In some instances it was possible to demonstrate these components of the tumor by injecting the internal and external carotid arteries for separate arteriograms. Group II (16 cases) was characterized by newly formed arteries with a regular lumen which were often arranged in a broomlike or a radial distribution. In Group III (6 cases) a wide branch from the external carotid artery was identified. Group IV (7 cases) showed a bowl-shaped arrangement of an artery around the tumor. Entirely normal arteriograms were encountered in 31 meningiomas (Group V).

A wide variance was found in the vascular patterns of metastatic tumors, and many of the patterns were not diagnostic. Six metastatic lesions showed evidence of arteriovenous fistulas resembling those encountered in Group I meningiomas. The metastatic tumors tended, however, to be irregularly ("polycyclically") outlined, while the meningiomas were almost always smoothly rounded. Two cases of metastasis showed a pattern like that of Type II glioblastomas, and 8 others were roentgenographically indistinguishable from Types III and IV glioblastomas. Vascularization of the tumor appeared entirely normal in 19 cases. Even the finding of multiple tumors was not conclusive evidence of metastases, as multiple meningiomas also were encountered.—*Arthur S. Tucker, M.D.*

Seaman, William B., and Schwartz, Henry G. Cerebral arteriography with sodium acetrizoate (urokon sodium) 30%. *A.M.A. Arch. Surg.*, Nov., 1953, *67*, 741–745.

In an effort to find a contrast medium which would be safe for cerebral arteriography, workers at Washington University have used sodium acetrizoate (urokon sodium) 30 per cent in obtaining 297 cerebral angiograms in 125 patients. The amount of acetrizoate used for each arteriogram ranged from 6 to 20 cc., with an average of 9 cc. Seventy-one of the patients had bilateral arteriograms. Subjective dis-

comfort was less than that usually found with other contrast media.

Minor reactions occurred in 20, or 16 per cent, of the patients. Major reactions developed in 7, a case incidence of 5.6 per cent, and carotid injection in 3, an incidence of 2.3 per cent. One of these patients died twenty-four hours after angiography from hemorrhage into a glioma of the brain stem which probably was engendered by an extreme position of hyperextension during the performance of the arteriography. Apart from this patient, the principal reaction was hemiparesis, which was in some instances transient. Two patients had hemiparesis to begin with, which arteriography served to accentuate.

Five of the 7 patients with complications were in the sixth and seventh decades; 3 were hypertensive. —*Arthur S. Tucker, M.D.*

Masy, S., and Grégoire, A. La cisternographie. (Cisternography.) *J. belge de radiol.*, 1953, *36*, 416–443.

This is a thorough review of the anatomy, physiology and roentgenographic appearance of the cisterns of the brain. The subject is considered in detail, not only with respect to the distribution and arrangement of the cisterns, but also as regards the relationships of cerebral and cerebellar structures which can be identified in them, for example nerve origins, vessels, etc. The authors include such structures as the sylvian fissure and supracallosal sulcus in the cisternal system, and describe them, as well as the others, carefully and minutely.

The examination is conducted on the roentgenographic table with the patient prone in the Trendelenburg position. Through a lumbar puncture 20 cc. of air is injected. When the table is returned to horizontal position or elevated to an angle of 45 degrees, air fills the posterior cisterns. Exposures are made in frontal and lateral projections. The patient is then turned on his back and the anterior cisterns are filled and roentgenograms made of these. It is possible, by making exposures at more or less rapid intervals, to determine the passage time of air from cistern to cistern. The authors have tried a method whereby the examination is made with the patient erect, leaving the lumbar puncture needle in place and injecting air while making roentgenograms at intervals, but have found it too exhausting and inhuman.

The procedure has value in furnishing information regarding: (1) the permeability of the cisterns or the hydrodynamics of transit of gasses; (2) the state of the structures which they contain—vessels, nerves, etc.; (3) the morphology of the cisterns.

(1) The passage of air may be slowed or arrested as the result of infection, such as acute or tuberculous meningitis. They quote Peuch (*Semaine des hôpitaux*, Dec. 22, 1950, p. 4831) who has worked out the following scheme to determine the site of obstruction: (a) complete filling of ventricles, cisterns and cortex —no block; (b) filling of cisterns, cortex and 4th ventricle—block of aqueduct of Sylvius; (c) filling of cisterns, cortex, 4th ventricle, aqueduct, 3rd ventricle and of only one lateral ventricle—block of the foramen of Monro; (d) filling of cisterns, cortex and neither ventricle—obstruction of the foramen of Magendie; (e) filling of the ventral cisterns without air in the cortical furrows—obstruction of the level of the chiasmatic or prepontine cisterns.

(2) It is possible to obtain considerable information regarding the nerves and vessels contained in the cisterns, though there is danger of being misled by false images, poor visualization, localized collections of gas, etc. The authors have identified a tumor of the optic nerve and quote others who have also diagnosed tumors and tuberculosis of the chiasma.

(3) Changes in the morphology of the cisterns are also of some diagnostic significance.

The authors conclude that there are many indications for formal examination of the cranial cisterns and they state that the method is simple, of very slight danger and, while interpretation of the roentgenograms is delicate, much useful information may be obtained in certain cases.

This is an extremely well prepared and clearly illustrated article, showing in roentgenographic reproductions and accompanying detail sketches, the appearance of the cisterns of the brain both in normal and in many abnormal conditions.—*Angus K. Wilson, M.D.*

Neck and Chest

Dazzi, Carlo. Ipertrofia tonsillare e adenopatia mediastino-ilare. (Hypertrophy of the tonsils and mediastinal hilar adenopathy.) *Ann. radiol. diag.*, 1953, *26*, 115–152.

In this study 116 children with hypertrophy of the tonsils were carefully examined and tested with intradermal tuberculin. Routine roentgenograms of the chest were made supplemented with laminagrams.

In 72 of these cases the plain roentgenogram of the chest showed no abnormalities in the hilar areas and the tuberculin test was negative, thus no further studies were done. In the remaining 44 cases in which hilar adenopathy was present, laminagrams were taken. In 24 of these cases the mediastinal and hilar adenopathy was demonstrated in greater detail and could be more accurately located. These 24 cases are reported in detail and many fine illustrations of laminagrams are included in the article. In all of these cases, except 1, the Mantoux test was positive. In 1 case a pulmonary tuberculous lesion was demonstrated and in another there was pleural involvement.

The author found an incidence of 20 per cent of hypertrophied tonsils with mediastinal hilar adenop-

athy to be due to tuberculous infection. The laminagrams were very helpful in determining the site and extent of involvement of the paratracheal, peribronchial and perihilar lymph nodes.—*Peter E. Russo, M.D.*

Dancot, H. Les cylindromes des glandes salivaires; étude de 19 cas. (Cylindromas of the salivary glands; a study of 19 cases.) *Bull. Assoc. franç. l'étude cancer*, 1953, *40*, 383–396.

The author distinguishes the cylindromas from other malignant salivary gland tumors not only histopathologically but also clinically by their local character and slow growth with the tendency to metastasize to lungs rather than to regional lymph nodes. The lung metastases are usually silent. The 19 cases studied by the author were distributed among the parotid, submaxillary and sublingual glands and were also found in the palate, auditory canal and maxillary sinus. The author confirmed the observation of Baclesse that these tumors can be made to disappear by proper irradiation. A tumor dose of 6,500 r to 8,000 r protracted over a period of ten to twelve weeks caused slow regression of the tumor which usually did not disappear until several weeks after the completion of the therapy.

Remissions of five to eighteen years were obtained in 13 cases, while 6 cases which were treated recently responded well. It is possible to cure some of these cases by surgery alone, but the excellent response to irradiation warrants the use of radiation therapy in all cases, either as the primary method of treatment for those tumors not accessible to surgery or as a postoperative measure after surgical removal.—*Sidney M. Silverstone, M.D.*

Warren, Shields, Alvizouri, Mario, and Colcock, Bentley P. Carcinoma of the thyroid in childhood and adolescence. *Cancer*, Nov., 1953, *6*, 1139–1146.

A series of 23 cases of carcinoma of the thyroid in patients less than twenty years of age is added to the 237 already reported in the literature. The incidence of carcinoma of the thyroid in over 23,000 thyroid operations at the Lahey Clinic was 2.5 per cent and the cases under twenty years represented 3.7 per cent of the total carcinoma cases (23).

A review of the literature reveals 237 cases under twenty years, including those reported by Winship fourteen years and younger. The occurrence of these tumors increases slowly with age leveling off at thirty years. The higher incidence in females is also demonstrated during childhood and adolescence.

In all 23 cases here reported the first evidence of disease was development of a lump either in the thyroid or lateral neck. Masses in the neck had existed since birth in 7 cases. There were no significant etiological factors. Two of the mothers had a history of "goiter." None of the mothers had been treated with iodine, thyroid or goitrogens during pregnancy. Only 1 patient had had radiation therapy for enlarged thymus. A solitary thyroid nodule preceded carcinoma in at least 10 per cent of the Lahey clinic carcinoma cases and higher incidences are reported elsewhere.

The diagnosis in clear-cut cases is made easily. Borderline cases where portions of the gland are normal cause the major difficulties. The most useful histological criterion in these cases is invasion of blood vessels, lymphatics or capsule. In children papillary adenocarcinoma was present in 47.7 per cent, while the second most frequent type was small cell carcinoma, 17.3 per cent. In the cases reported in the literature, papillary adenocarcinoma represented 53 per cent and adenocarcinoma 20 per cent.

In these 23 cases the symptoms averaged two years, but ranged from three months to nine years. Fourteen patients already had lymph node metastases at the time of initial examination. Six were diagnosed clinically as having lateral aberrant thyroid and all cases histopathologically were shown to have metastatic thyroid carcinoma. The metastases went first to the lymph nodes in the anterior and posterior triangle of the same side of the neck and next to the lungs.

The present method of therapy is based on the cell type and clinical degree of involvement. If pathological study of a solitary nodule shows carcinoma, a radical neck dissection with total removal of the thyroid lobe and isthmus is done. All patients subsequently receive roentgen therapy to tolerance limit. Both sides of the neck are treated even though only one side is involved. The field of irradiation extends from the lymph nodes at the angle of the mandible down, including the supraclavicular region and the mediastinum, to the bifurcation of the trachea.

If carcinoma is suspected at the primary operation and confirmed by frozen section a radical neck dissection with total lobectomy on the involved side is performed. This is also done in all patients who have adenoma with blood vessel invasion or follicular or papillary adenocarcinoma. However, in undifferentiated carcinoma of the large or giant cell type, in sarcoma and in lymphoma, a radical neck dissection is omitted since the poor prognosis does not justify the more extensive procedure.

Follow-up in the literature is scanty but there are 17 cases reported alive for more than ten years. Twenty-two of the 23 Lahey Clinic cases have been followed and 4 are dead. Eighteen are alive and well, 3 more than five years and 7 more than ten years. One patient surviving twenty-two years had cervical recurrences at six and nine years treated surgically, and at twelve years pulmonary metastases, treated by roentgen therapy. The patient is now well without evidence of recurrence. Three patients had colloid adenomatous goiters after surgery and are now well ten to fifteen years. One patient with an advanced

small cell carcinoma has been followed seventeen years after roentgen therapy only; his pulmonary metastases also disappeared after the irradiation. Four patients died, 2 had papillary adenocarcinoma with diffuse metastases and 2 had small cell cardinoma.—*Martha Mottram, M.D.*

Littleton, J. T., Motsay, D. S., and Perry, S. P. Thymus problem. *A.M.A. Am. J. Dis. Child.*, Dec., 1953, *86*, 705–716.

The authors state that the purpose of their paper is to review the theories by which the thymus has been maligned, analyze its fundamental structure, relate an experience of their own with reference to the current concepts of the thymus, present evidence against the obstructive theory, and suggest a possible viewpoint to be taken by the physician when confronted with the thymus problem.

Five principal theories have been proposed as to how the thymus causes symptoms and death: The first is the obstructive theory, according to which the thymus produces mechanical pressure on the trachea, blood bessels, and nerves, particularly the recurrent laryngeal and vagus. The second is that of status thymolymphaticus, which ascribes death to a constitutional defect associated with hyperplasia of the thymus, especially the medulla, and a general lymphoid hyperplasia with hypoplasia of the adrenals and cardiovascular system. A third theory is anaphylaxis. A fourth attributes death to an excessive and abnormal thymic secretion which results in a lymphotoxemia. The fifth suggests that death might be due to a hypersusceptibility to a physical and chemical agent.

The authors conclude that there is little concrete evidence to support any of these five theories linking the thymus gland to symptoms of stridor, cough and cyanosis or to sudden death. They state that these facts are not generally appreciated and many practitioners, pediatricians, and radiologists are still treating widened mediastinal shadows and symptoms of cough, stridor, cyanosis with radiation therapy. They believe, too, that by having kept attention finely focused on the thymus, a definite clinical entity of low grade, chronic or recurrent tracheobronchitis may well have been overlooked, a condition which is best managed or at least aided by roentgen therapy.—*Ralph S. Bromer, M.D.*

Reinhardt, K. Ein Jodöl-Sulfonamidpudergemisch als Bronchographiekontrastmittel. (An iodized oil-sulfonamide powder mixture as bronchographic contrast material.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1953, *79*, 699–704.

Lipiodol and iodipin have certain disadvantages as contrast materials for bronchography. They often remain in the lungs for a considerable time and may cause a chronic pneumonitis. They are easily aspirated into the alveoli and thus may obscure some bronchi. Water-soluble contrast media with a high viscosity do not seem to have fulfilled what they seemed to promise. These substances seem to be more irritating and require greater local anesthesia. Some of them have such a high viscosity that they obstruct some bronchi.

A mixture of 20 cc. of 40 per cent lipiodol with 6 to 10 gm. of sulfonamide powder (properly prepared in a pharmacy) has been proposed by Dorner, Friedländer and Wiles. The viscosity of the mixture is supposedly increased three times as compared with lipiodol. The author has found the mixture very advantageous and reports good results. It is not more irritating than lipiodol used alone. It flows slowly into the bronchial tree and does not fill the alveoli as readily as lipiodol. In most cases it disappeared roentgenographically within twenty-four hours. In no case in the author's experience could it be demonstrated after six days. By changing the amount of the sulfonamide powder, one is able to decrease or increase the viscosity; or one may use the 20 per cent lipiodol which makes the mixture considerably thinner.—*Hans W. Hefke, M.D.*

Forsee, James H., Farinacci, Charles J., and Blake, Hu A. Ectopia of primary thymic tumors. *Ann. Surg.*, Dec., 1953, *138*, 922–924.

Three cases of ectopic primary thymic tumors are discussed. Two cases were detected as mass lesions in the superior mediastinum in chest roentgenograms. Lateral roentgenograms located the tumors in the vertebral gutter. Exploratory thoracotomy and histopathologic examination revealed thymomas of the posterior mediastinum.

The third case showed a large cyst-like area on the right in the chest roentgenogram. Right thoracotomy revealed a cyst adherent to the right middle lobe with a nodule in its lateral wall. Histopathological examination again showed a malignant thymoma.

A bibliography of similar tumors is included in the article.—*P. B. Parsons, M.D.*

Robert, F., Riberi, A., and Testini, A. Sulla tecnica del doppio contrasto nell'esame radiologico dell'esofago. (On the technique of double contrast media in the roentgen examination of the esophagus. *Ann. radiol. diag.*, 1953, *26*, 243–249.

The authors have developed methods to obtain double contrast studies of the esophagus. In one procedure a teaspoonful of carbonated compound is given by mouth followed by a teaspoonful of thick barium. The release of carbon dioxide distends the esophagus and serial roentgenograms are taken without visualization under the fluoroscopic screen. A more physiological procedure is the administration

of the barium with a nursing bottle and again making roentgenograms during the process of swallowing.

This article is well illustrated with several excellent roentgenographic reproductions. A contribution to more detailed visualization of esophageal lesions has been made.—*Peter E. Russo, M.D.*

Kirchhoff, Hans W., Zur Differentialdiagnose der Mittelschattenveränderungen im frühen Kindesalter. (Differential diagnosis of the changes in the mediastinum in early infancy.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1953, *79*, 557–567.

The mediastinum occupies about half of the chest cavity during fetal life and one-third of it during early infancy. This is due in part to the size of the heart, the visibility of the thymus and the high position of the diaphragm. Standard measurements are not available but the author furnishes contour drawings of the mediastinum for different months between birth and the age of one year, made by taking the average from numerous chest roentgenograms of each age group. The aortic arch is usually not visible in the young child. Enlargement of the normal mediastinal shadow is not rare. It might be due to tumors, such as sympathicoblastoma, or, most commonly, either to enlargement of the thymus or to pleurisy of the superior mediastinum.

The size and form of the thymus are very variable and often asymmetrical, usually more sharply outlined on the left, with changes always apparent during fluoroscopy in different phases of respiration. Mediastinal pleurisy is only found during the first two years of life. The author observed it in 69 instances out of 973 chest examinations of children of less than two years of age. It might cause symptoms of infection or be entirely symptomless. Its diagnosis is only possible by roentgenologic examination, the most common type being the anterior superior right mediastinal pleurisy (59 cases). The roentgenograms show evidence of enlargement of the upper mediastinum to the right, sometimes with roof-like appearance at the upper hilar region and a sharply defined border in this area, often extending into the horizontal fissure. Simultaneous involvement of the right upper lobe was found in 23 cases. Not infrequently, the right hilar lymph nodes are also involved; these can be well demonstrated by means of laminagraphy, which also serves to delineate the shadow of the thymus, usually difficult to separate on conventional roentgenograms or during fluoroscopy. Tuberculosis as an etiological factor is uncommon. The large hilar lymph nodes sometimes cause atelectasis, mostly of the segmental type. Tuberculosis, on the other hand, might cause fibrosis of a lobe or of a lobar segment.

The article is illustrated with a number of line drawings and nine excellent roentgenographic reproductions.—*E. G. Wissing, M.D.*

Sloan, Robert D., and Cooley, Robert N. Coarctation of the aorta; the roentgenologic aspects of one hundred and twenty-five surgically confirmed cases. *Radiology*, Nov., 1953, *61*, 701–721.

The roentgenologic aspects of 125 surgically confirmed cases of coarctation of the aorta are discussed. There were 88 males and 37 females in this series.

The coarctation is divided into three general types based on the practical anatomical aspects of the anomaly in relation to its surgical treatment. In Type I the coarctation is located somewhere between the origin of the left subclavian artery and the region of the ligamentum or ductus arteriosus and its length, and nature are such as to permit definitive surgery. Eighty-nine per cent of the authors' series were of this type. In Type II the coarctation is as in Type I but its length and nature is such that definitive surgery is not possible. Eight per cent were of this type. In Type III the coarctation is not located in the usual site, being found anywhere in the aorta. Three per cent were of this type, and in some, definitive surgery was possible.

The radiologist has two basic responsibilities in cases of coarctation. First, he must suggest this diagnosis, if not already made, on the basis of routine chest roentgenograms, fluoroscopy, and/or barium swallow studies. Secondly, once the diagnosis has been made, he must evaluate the roentgenologic status of the heart and great vessels, the collateral circulation and, if possible, the site and anatomy of the coarctation itself.

The roentgenologic findings in order of their practical importance are presented and discussed. Notching of the ribs, on their inferior margins due to tortuous intercostal arteries, usually of the fourth through the eighth ribs and occasionally the third and ninth ribs, is frequently found. The majority of patients in whom this is present are in the second and third decades. Seventy per cent of the patients in this series had this finding. The figure "3" sign is due to a defect or break in the continuity of the actual narrowed area in the aorta and was present in 26 per cent. The aortic knob shadow was absent in 58 per cent, this being due to a relative hypoplasia of the arch or the anterior and medial displacement of the aorta at the site of insertion of the ligamentum arteriosum.

Occasionally the esophagus is displaced to the right and anteriorly by the dilated post-stenotic segment. Fifty-four per cent of the patients showed left ventricular enlargement, secondary, usually to the hypertension. Five per cent had generalized cardiac enlargement, this being present in relatively young children. Tortuosity or dilatation of the ascending aorta was present in 32 per cent, while in the remainder the aorta was not abnormally prominent.

The authors also discuss the value of contrast

vascular studies such as angiocardiography and aortography. These procedures are carried out to confirm the clinical impression and to demonstrate the anatomy of the abnormality. The authors suggest, however, that these techniques be used only when there is a suspicion that the coarctation is atypical or where routine roentgenologic studies give no clear indication as to the site of the stenosis.—*Donald N. Dysart, M.D.*

Jönsson, Gunnar, Brodén, Bror, and Karnell, Johan. Angiocardiographic demonstration of pulmonary stenosis. *Acta radiol.*, Dec., 1953, *40*, 547–553.

The authors quote recent radiological literature concerning the difficulty of visualizing the outflow tract of the right ventricle and pulmonary valves by intravenous angiocardiography. They believe that such unsatisfactory visualization has been due to hesitancy of the operator to inject contrast medium directly into the right ventricle with possible dangerous side-reaction, or the troublesome and time-consuming procedure required for such visualization.

Selective visualization of the outflow tract of the right ventricle was obtained following intravenous catheterization with location of the catheter tip in the upper part of the pulmonary conus, immediately below the valves, lying freely in the lumen. A 70 per cent solution of umbradil (1 cc. per kilogram of body weight) was injected with the aid of a pressure device at the rate of 15–20 cc. per second. Irritability of the myocardium was reduced by preliminary slow injection of 120 cc. 0.25 per cent ethocaine through the catheter in 5–10 minutes. Simultaneous anteroposterior and lateral roentgenograms were made at the rate of six per second. Intravenous injection into the superior vena cava was reserved for those cases in which catheterization was impossible.

Over 100 such selective visualizations of the outflow tract were made without serious complication. Kjellberg used a similar method with equally good results in 150 cases (Kjellberg, S. R. Some aspects on angiocardiography in children. Seventh International Congress of Radiology, 1953. Abstracts of papers, p. 55).—*J. Maurice Swain, M.D.*

Cooper, George, Jr., Birdsong, McLemore, and Bradshaw, Randolph. Emergencies in the newborn. *J.A.M.A.*, Nov. 21, 1953, *153*, 1077–1080.

The authors review the emergencies encountered in the newborn with special emphasis on the possible contributions of the roentgenologist in arriving at an accurate diagnosis. They discuss the value of the chest roentgenogram in the diagnosis of respiratory and circulatory embarrassment, pulmonary maldevelopment, atelectasis, pulmonary hyaline membrane disease, positive pressure pneumothorax, high tension cysts, diaphragmatic hernia, cardiac abnormalities and in esophageal lesions.

The routine examination of the abdomen, with or without the use of contrast media, is of value in identifying and studying renal masses, intestinal obstruction, and imperforate anus.

The authors combine the pertinent clinical features of these abnormalities and correlate them with the findings on the roentgenogram.—*James F. Martin, M.D.*

Volbeding, K. H., and Repkewitz, R. Über Röntgenbefunde bei der Poliomyelitis unter besonderer Berücksichtigung der Lungenveränderungen. (On roentgen findings in poliomyelitis with special emphasis on pulmonary changes.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1953, *79*, 622–633.

Lately, poliomyelitis has been on the increase and epidemics have been reported from the United States and England which had 7,500 cases in 1947. There has also been an increased incidence in parts of Germany. In 1947, there were 2,400 cases in Berlin and 446 cases in Hamburg, which is ten times the average frequency of the previous ten years.

In cases with respiratory paresis, pulmonary complications are often of decisive importance. Some of these complications appear to be characteristic. Most of them show the picture of atelectasis, either massive, or—less commonly—focal. The authors describe 14 cases of massive atelectasis, partly with, but mostly without increase in temperature, but all with paresis of the intercostal musculature and the diaphragm. In some cases, a large amount of secretion was aspirated.

The article contains fifteen roentgenographic reproductions. They show various stages of massive atelectasis with marked mediastinal and cardiac displacement and with evidence of complete or incomplete re-expansion after removal of the cause for the collapse.—*E. G. Wissing, M.D.*

Gombert, H. J. Seltene Ursachen oder Formen intermittierender und konstanter Atelektasen. (Rare causes and types of intermittent and constant atelectasis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Nov., 1953, *79*, 599–613.

This article contains a brief discussion of the etiology and diagnosis of different types of atelectasis and an extensive description of 3 of the author's cases.

The first case is that of a twenty year old man with intermittent left-sided atelectasis of one or both lobes preceded by poliomyelitis two years before with residual spastic paresis of the left arm and left thorax and back musculature. The patient had several epi-

sodes of chest pain and cough, each with roentgen evidence of atelectasis of an entire lobe.

The second case is that of a sixty-five year old woman with bronchogenic carcinoma of the right upper lobe bronchus with increasing atelectasis of that lobe. In addition, pieces of the necrotizing tumor separated from it and caused intermittent middle or lower lobe atelectasis.

The third case is that of a carcinoma of the right lower lobe bronchus in the presence of congenital anomalies of the lower and middle lobes and bronchitis fibrosa of the right upper lobe, which caused intermittent atelectasis of that lobe. A pneumonectomy was performed on this patient.

The article is well illustrated with 18 roentgenographic reproductions.—*E. G. Wissing, M.D.*

Katz, Sol., Storey, Patrick, B., McCormick, Georges F., Palacios, Hector, and Penso, Angel DeLeon. Bronchography with a water-soluble contrast medium (umbradil). *Am. Rev. Tuberc.*, Nov., 1953, *68*, 760–764.

The irritating properties of umbradil as a water-soluble medium for bronchography was again confirmed.

Methods usually employed for topical anesthesia of the tracheobronchial tree were found completely inadequate. Precise fractional instillation of 0.33 per cent pontocaine by catheter into the lobar and segmental orifices was necessary.

In 45 bronchographic studies, only 15 patients (43 per cent) gave usable bronchograms in that the desired information was obtained and the procedure did not have to be repeated.

The authors felt umbradil was of value in selected cases where only limited (lobar) bronchography is needed and retention of a contrast medium in the lung is especially undesirable. Overflow of umbradil in these cases must be avoided because uncontrollable coughing will ensue.—*George A. Miller, M.D.*

Miceli, Roberto. Polmone policistico-bronchiettasico. Contributo radiologico. (Polycystic bronchiectatic lung; roentgenological contribution.) *Lotta contro tuberc.*, July, 1953, *23*, 463–500.

Considering the morbid anatomy of the cystic lung, it may originate (1) in the bronchi (bronchiectasis or bronchial hyperplasia), (2) in the alveoli (likewise by dilatation or hyperplasia), and (3) in the lymphatics (due to either lymphangiectasis or lymphangioma). The existence of the third group is controversial.

The condition is asymptomatic during most of the remissions. Among its clinical entities, various types are described such as (a) pneumothroacic, (b) pseudotuberculous, (c) associated with secondary infection, and the rare (d) associated with tuberculosis.

Although the disease may be acquired as the result of (long standing?) inflammatory processes, it is supposedly superimposed on a structural predisposition. Most cases are believed to be altogether of congenital origin, and these show the typical roentgenological appearance of multiple, overlapping, circular or polygonal trabeculations. This basic feature will be encountered also on the lateral views and during laminagraphy, regardless of type (oligocystic and polycystic), size (megacystic or microcystic), and extent (scattered or localized). The resemblance to sliced Swiss cheese is stressed.

Laminagraphic study is also useful for proper evaluation prior to surgical removal of strictly localized disease. In such cases, bronchography is a preoperative requirement. Kymographic examination is suggested, intended to demonstrate shift of the mediastinum during inspiration toward the cystic (and atelectatic or secondarily fibrosclerotic) lung, which would indicate decreased respiratory function. In cases beyond surgical approach, antibiotic therapy is advisable, applied in adults through endobronchial catheters.

Seven cases are described, their presentation being limited to the diagnostic procedures involved.—*E. R. N. Grigg, M.D.*

Roswit, B., Kaplan, G., and Jacobson, H. G. The superior vena cava obstruction syndrome in bronchogenic carcinoma; pathologic physiology and therapeutic management. *Radiology*, Nov., 1953, *61*, 722–737.

The authors discuss the superior vena cava obstruction syndrome due to proved bronchogenic carcinoma from the standpoint of pathologic physiology, roentgenographic features, clinical picture, and therapeutic management. Thirty-eight cases comprise their present series. It is pointed out that this vessel is particularly vulnerable to obstruction by primary bronchial cancer with metastatic nodes because of its location. Obstruction occurred in 15 per cent of the authors' series, most frequently in cases with right-sided, anaplastic lesions.

When obstruction occurs above the azygos vein, this vein takes over the function of the superior vena cava, resulting in prominence of collaterals in the neck, shoulder girdles and upper thorax. When obstruction occurs below the azygos arch, venous return to the heart is by a much more circuitous route, involving superficial and deep channels of the lower abdominal wall, the back, and the groin.

The symptom-complex encountered grows in severity as the venous pressure mounts, with progressive dyspnea, orthopnea, cough, cyanosis,

edema of the head, neck and upper thorax, and headache. Venous pressure measurements in the fully developed syndrome are invariably above 150 mm. of saline.

Conventional roentgenograms usually show a space-occupying primary tumor or a metastatic mass in the right anterior superior mediastinum; phlebography and angiocardiography are useful in revealing the site and nature of the obstruction. Regression following treatment is frequently noted on the films.

Roentgen therapy, utilizing 400 kv. (h.v.l. 4.7 mm. Cu), and delivering 3,500 to 4,500 r to the tumor was employed. The authors cite their experience with nitrogen mustard alone, and as an adjunct to roentgen therapy, but feel that roentgen therapy is the treatment of choice, reserving the nitrogen mustard for those intervals when roentgen therapy is unfeasible or ineffective. More than two-thirds of their patients responded favorably to therapy, some obtaining dramatic clinical improvement from the grave and distressing symptoms of this entity.—*Michael J. Healy, M.D.*

Mitchell, Roger S. Roentgenographic spreads of pulmonary tuberculosis occurring during sanatorium residence before the use of prolonged chemotherapy. *Am. Rev. Tuberc.*, Dec., 1953, *68*, 863–873.

The reports of serial chest roentgenograms in all patients admitted to the Trudeau Sanatorium between July 1, 1946 and June 30, 1951 except those that were not discharged by December 31, 1951 were reviewed. Spread of tuberculosis was defined as any definite increase in the abnormal shadows seen on routine stereoscopic examinations made at four to eight week intervals during the sanatorium course. Spread of pulmonary tuberculosis was no more apt to occur in advanced than in minimal disease.

In patients with minimal tuberculosis spreads were more common in the 15–23 year age group than in those 24–25 years old, particularly in males. The seasonal and yearly incidence of spreads was highest in summer and lowest in winter and fall. Spread tended to be more extensive in the presence of a cavity.

The behavior of minimal tuberculosis in the sanatorium may be more reliably predicted from the findings on sputum culture and gastric washings than from examinations of sputum smears. The prolonged uninterrupted use of streptomycin—PAS therapy—was accompanied by an impressive reduction in the incidence of pulmonary tuberculosis during the sanatorium residence.—*P. B. Parsons, M.D.*

Marchal, Maurice. La ciné-densigraphie et l'exploration des tumeurs du poumon. Technique de la ciné-densigraphie. (Cinedensography and the exploration of lung tumors: technique of cinedensography.) *Presse méd.*, Dec. 25, 1953, *61*, 1734–1736.

The method registers the kinetics and density variations in the pulmonary parenchyma and is thought to record the "capillary pulse." The apparatus is similar to that used in electrokymography but is more sensitive and permits standardization of the densogram as a function of the quantity of the roentgen rays traversing the subject. It is possible also to record the "vital capacity" of the segment of lung under study.

Pulsation transmitted from the ventricles or great vessels must be differentiated from the intrinsic pulsation of the parenchyma. Transmitted "ventricular" pulsation results in an M curve, the first peak being due to the transmitted ventricular pulsation, the second to the intrinsic parenchymal pulsation. Near the great vessels of the base, however, this differentiation is not valid because there is an intrinsic and transmitted arterial pulsation. For this reason a system of "crossed" photoelectric cells is used. Supplementary recording during forced inspiration also permits excluding a transmitted pulsation. Patients with tachycardia must be sedated.

The article describes the "normal" curve in some detail. In pathologic states, there is said to be sometimes a complete suppression of the pulmonary pulse. The regular arterial curve which bears a definite relation to the R wave is replaced by vibrations unrelated to the electrocardiogram. In other cases, the timing is unchanged but the amplitude of pulsations is smaller and/or there may be multiple peaks. During a period of two or three R waves, expansion may be lacking entirely.—*M. L. Sussman, M.D.*

Ravina, A., Marchal, M., and Pestel, M. La ciné-densigraphie et l'exploration des tumeurs du poumon. Application de la ciné-densigraphie à l'exploration des tumeurs du poumon. (Cinedensography and the exploration of lung tumors; application of cinedensography to the study of lung tumors.) *Presse méd.*, Dec. 25, 1953, *61*, 1736–1737.

Five cases are reported in which either all or part of conventional examinations were unrevealing. The latter included bronchoscopy, bronchial aspirates and pulmonary angiography. In these cases, only cinedensography established absence of pulsation over the lesion, which was considered evidence of malignancy while a normal pulsation was evidence of a benign process. The clinical evolution of the cases confirmed the diagnoses.—*M. L. Sussman, M.D.*

Mannix, Edgar, P., Jr. Resection of multiple pulmonary metastases fourteen years after amputation for osteochondrogenic sarcoma of tibia; apparent freedom from recurrence two

years later. *J. Thoracic Surg.*, Nov., 1953, *26*, 544–549.

The author reports a case of a thirty-nine year old female who had pulmonary metastases fourteen years after a mid-thigh amputation for an osteochondrogenic sarcoma of the tibia. In 1949, fourteen years after the amputation, she developed left chest pain, night sweats, cough and hemoptysis. At that time, an oval density with calcification was seen only on a lateral roentgenogram and thought to represent a tuberculoma. During the succeeding year, the symptoms persisted and the lung lesion enlarged. At operation, six lesions having the microscopic appearance of osteochondromata, and appearing less malignant than the original lesion were removed by segmental resection. The lesions ranged in size from 20 mm. to 4 mm. and were located in the basilar segments and lingula of the left lung. On review of a laminagram made at 2 cm. level, a second neoplasm was detected.

The patient has been followed two years after the segmental resection and has shown no symptoms or findings of more metastases.—*Paul C. Olfelt, M.D.*

Abdomen

Shufflebarger, Harold E., Knoefel, Peter K., Telford, Jane, Davis, Lawrence A., and Pirkey, Everett L. Some factors influencing the roentgen visualization of the mucosal pattern of the gastrointestinal tract. *Radiology*, Nov., 1953, *61*, 801–806.

In the past there have been repeated attempts to improve the quality of roentgen visualization of the mucosal pattern of the gastrointestinal tract by using different media, adjuvants to the standard media, and barium sulfate of small particle size. There have been no detailed investigations relating the state of individual resting gastric function, such as pH, mucin production, and motility, to the mucosal pattern obtained on films or at fluoroscopy, nor has there been any correlation between the type of stomach and the excellence of mucosal detail obtained.

The authors present the results obtained from experiments performed on 3 dogs and 9 human subjects. They found that for the visualization of the gastric mucosal pattern in the dog under basal conditions, 0.5 μ $BaSO_4$ and $VaSO_4$, USP gave similar results. Results with 0.35 μ $BaSO_4$, 1.05 μ $BaSO_4$, and micropowder $BaSO_4$ were not as good as with 0.5 μ $BaSO_4$, and $BaSO_4$ USP. Also, it was noted that in both animals and man there was a tendency toward similarity between the different examinations of the same subject and marked variation among individuals. Visualization of the mucosal pattern could not be correlated with gastric secretory activity. In human subjects, the best consistent patterns were obtained in those with hyposthenic type stomachs.—*A. Ralph Watson, M.D.*

Frik, W., and Zeidner, A. Röntgenuntersuchungen des Magenfeinreliefs. I. Mitteillung (Zur Bedeutung der sogenannten Gastritis granularis). (Roentgen examination of the fine gastric mucosal relief. I. The importance of so-called granular gastritis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1953, *79*, 681–692.

The possibility of roentgen diagnosis of gastritis by means of mucosal relief studies has been subjected to intensive scrutiny by the authors.

This article is based on 1,700 such examinations with particular attention to the fine relief of the mucosa. They succeeded in demonstrating in 62 per cent of a part of the series a fine granular relief of the mucosa which they believe is caused by the areae gastricae. The evaluation of 1,000 examinations makes it likely that this finely granular appearance of the gastric mucosal relief is probably normal and not a roentgen sign of granular gastritis. They consider only abnormal shapes of this pattern and an abnormal size of the areae gastricae to be of pathologic significance. A finely granular appearance of the mucosa was found in many normal patients; for instance, in 7 of 13 physicians selected at random who had no gastric symptoms. In many cases with this roentgen appearance gastroscopy showed no abnormalities.

Biopsies by means of the gastroscope are at present used by the authors in order to get further definite tissue proof that the granular mucosal relief is not to be considered abnormal nor a sign of gastritis. *Hans W. Hefke, M.D.*

Gomes, Frederico de Azevedo. Diagnóstico e tratamento do prolapso da mucosa gástrica. (Diagnosis and treatment of prolapse of the gastric mucosa.) *Rev. brasil. de gastroenterol.*, Nov.–Dec., 1953, *5*, 611–616.

Collapse of the gastric mucosa as a clinical entity has given rise to considerable discussion in the medical literature during the past few years.

According to the author, the following roentgen signs favor the diagnosis of gastric prolapse: (1) the duodenal bulb assumes the appearance of an "open umbrella"; (2) the mucous folds are visible as negative lines passing from the esophagus into the duodenum; (3) the appearance of the bulb varies with the degree of mucosal passage through the pylorus; (4) during temporary reduction of the prolapse, the redundant mucosa can assume, in the antrum, a circular or transverse direction instead of the usual longitudinal direction or it may assume a horizontal direction and may appear normal; (5) the peristaltic waves pass normally across the pylorus; (6) there is

generally no elongation or narrowing of the pyloric canal; (7) the size of the rugae is normal; (8) there is no irritability of the duodenal bulb; (9) no ulcer niches can be demonstrated in the pylorus or in the duodenum; (10) no gastric retention is present.

Differential diagnosis includes pedunculated tumor, partial pyloric obstruction, hypertrophic gastritis and cancer of the antrum of the stomach. This differential diagnosis may be very difficult or impossible roentgenologically.

The treatment may be conservative or surgical. The conservative treatment corresponds to that used in peptic ulcer. Surgical intervention is only indicated in complicated cases of prolapsed gastric mucosa, with severe hemorrhage, pyloric obstruction or suspicion of malignancy.—*Ernst A. Schmidt, M.D.*

Lewitan, Alexander. Roentgenologic study of Meckel's diverticulum; case report. *Radiology*, Nov., 1953, *61*, 796–800.

Though Meckel's diverticulum is a fairly common anomaly, its roentgen demonstration is most unusual. Only a few such instances are reported in the literature. Such a case is described in the present article.

A woman of thirty-five years had had post-prandial distress and varying cramping abdominal pain for three years. A Meckel's diverticulum was demonstrable by roentgen examination of the small intestine on two occasions. The area could not be visualized during colon examination due to overlying loops of ileum. Surgical intervention corroborated the diagnosis, and histologic examination revealed inflammatory changes. The patient became asymptomatic following surgery.

A finger-like projection, containing air trapped in it, was seen at the first roentgen examination. Definite peristaltic activity in this pouch was demonstrated on the illustrative films, with change of configuration and outline. Further, there was a marked shift in location of the diverticulum between the two examinations of the small intestine. This is in contrast to the early observation of Pfahler, who found the diverticulum to be often fixed in location and difficult to see on some subsequent examinations. In this patient, the diverticulum was well filled and the roentgenograms are excellent. These present findings are significant in aiding future diagnoses of the condition.—*William A. Goodrich, Jr., M.D.*

Hodges, Paul C. Roentgen examination of the colon. *J.A.M.A.*, Dec. 19, 1953, *153*, 1417–1421.

In this examination the competence and diligence of the examiner are vastly more important than the precise nature of the technique he employs. Medium and large neoplasms, diverticulosis, diverticulitis, and ulcerative colitis can be diagnosed rapidly and dependably by reasonably experienced, reasonably diligent radiologists. If we were able to do nothing more than diagnose gross lesions, our barium enema examinations would continue to be major contributions to the understanding of colon disease, but it is generally agreed that further improvement in the cure rate of colon neoplasm requires that in addition we become able to detect small polyps while they are still benign. The proctoscopist should be responsible for diagnosing those polyps that lie within the reach of his instrument, but above that level only roentgenology will suffice, and even it will succeed only when special techniques are employed. These techniques have to do with all three phases of the examination: (1) the preparation of the patient; (2) the nature and concentration of the vehicle in which the barium is suspended; and (3) the amount of enema administered, the manner of its introduction and removal, and the manipulation of the patient during fluoroscopy and film exposure.

Preparation of the patient: The patient takes only clear liquids for twenty-four hours before the colon examination and takes 2 ounces of castor oil twenty hours before the examination. No other cathartic is as effective and cleansing enemas are avoided whenever possible.

Suspending media: The ideal homogenized suspension for use as a barium enema should hold the bulk of the barium in suspension for long periods of time and yet deposit on the colon mucosa a thin barium sulfate film that will persist for from ten to fifteen minutes after the main portion of the enema has been expelled. The author is at present using an aqueous mucilage of sodium carboxymethylcellulose mixed with barium sulfate and water and run through a colloid mill. Carboxymethylcellulose is a synthetic gum, nontoxic, and not digested or precipitated by the acid or alkaline juices of the gastrointestinal tract.

Technical devices: Simple methods suffice where the volume of work is not too large. When a maximum number of patients must be examined in a minimum amount of time, time can be saved by employing special equipment. The apparatus consists mainly of a four-way pinchcock with crank-operated cams that close or open lines of rubber tubing. The first position allows barium to flow into the colon, the second position closes both filling and draining lines, the third position allows barium to flow out of the colon into the sewer, and the fourth position frees both lines so the "gates" can be opened and a new harness of enema tip and connecting lines substituted for the one used by the previous patient. The barium supply is stored in a 16 quart aluminum stockpot resting on a shelf clamped to a steel mast at the foot of the fluoroscopic table. This apparatus was patterned after one demonstrated by Dr. F. E. Templeton at the 1950 session of the American Medical Association. Inflation of the colon with air is accomplished following drainage of the colon, after which the supply and drainage lines are clamped

and the pinchcock to the air supply is opened. The air is forced through the system with a hand bulb.

It seems possible, in the author's opinion, that with better homogenized suspensions of barium sulfate the colon may be sufficiently well visualized by oral administration of barium that photofluorographic surveys of the colon may approximate the usefulness of small film chest surveys.—*A. B. Smith, M.D.*

SWENSON, PAUL C., and JEFFREY, ROBERT B. Limitations in the use of roentgen examination of the gastrointestinal tract. *J.A.M.A.*, Dec. 19, 1953, *153*, 1422–1424.

The conventional fluoroscopic and roentgenographic examination of the gastrointestinal tract remains the safest and most informative study of this system. The method, however, has many inherent limitations. Abnormality may exist without apparent detectable structural or functional changes in the gastrointestinal tract. In certain specific areas of the gastrointestinal tract it is difficult to demonstrate abnormalities even where they are known to be present. A Meckel's diverticulum is such an abnormality.

The demonstration of any gastrointestinal lesion is dependent on its size to a great extent. Until a mucosal lesion attains sufficient size to distort the mucosal pattern through ulceration, to produce a filling defect, or to interfere with the intramural nervous mechanism, thereby affecting or producing apparent inflexibility, it is likely to remain undetected. Extraluminal masses can be detected if they are large enough and closely enough associated with the gastrointestinal tract to produce pressure effects on the luminal silhouette.

In the esophagus small mucosal lesions may be missed by not having several films with different degrees of filling. Varices may be missed if collapsed from recent hemorrhage and may flatten out with peristalsis. Small superficial ulceration associated with diaphragmatic hernia or actual peptic ulceration is very difficult to detect.

In the stomach the greatest difficulty is at the upper end where palpation is not readily carried out. Intramural lesions often give trouble. Increased mucosal folds may be either of inflammatory origin or the result of intramural infiltration. Distinguishing between a simple ulcer and an ulcer associated with a cancer remains a great problem.

In the small intestine the intramural lesion that may produce very little effect on the mucosa is obviously difficult to demonstrate. The obstruction appears late and barium moves through rather rapidly. The swollen irregular mucosal pattern with segmentation and sometimes widening of the lumen is not specific and can be caused either by local intramural changes or mesenteric involvement. Pattern and transit time may be affected by allergy; tumor, either intramural or mesenteric; intramural inflammation and extraluminal masses.

In the colon the size of the lesion is the only limitation, if careful preparation is carried out. A neoplasm as small as 2 to 3 mm. may be demonstrated by a good double contrast roentgenogram.

An acknowledgment of the limitations of the roentgen examination is no apology for it but rather renders it more valuable in the hands of the person attempting to interpret the findings.—*A. B. Smith, M.D.*

SOMMER, A. W., and GOODRICH, W. A., JR. Gastric diverticula. *J.A.M.A.*, Dec. 19, 1953, *153*, 1424–1428.

The authors report on 21 cases found at the Scott and White Clinic of Temple, Texas during the past twenty-six years and find reports of 449 valid cases in the literature. The diagnosis was based on roentgen examination alone in two-thirds of the cases. A marked increase in the frequency of roentgen diagnosis of gastric diverticula is attributed by the authors to a renewed interest in diaphragmatic hernia. These studies necessitated fluoroscopic examination and roentgenograms in various positions which resulted in better visualization of defects in the cardiac end of the stomach.

Symptoms due to diverticulum of the stomach are usually vague, most frequently epigastric discomfort occurring shortly after eating. They are frequently lacking entirely. Bleeding is the commonest complication and aberrant pancreatic tissue was found in 15 specimens of those reported in the literature.

When filled with barium the diverticulum is seen as a smooth, sharply defined round or oval sac that is attached to the stomach by a relatively narrow neck. If incompletely filled with barium an air fluid level or double contrast effect may be obtained. Twenty of the 21 diverticula in this series were located on the posterior wall of the cardiac end of the stomach, 3 to 5 cm. from the esophagogastric junction. One was found in the prepyloric region on the greater curvature, 2 cm. from the pylorus. The diverticula varied from 1 to 5 cm. in size; 60 per cent of the patients were women; and only 6 patients had symptoms attributable to the diverticulum. Pain was present in each of these patients.

Three patients were subjected to surgery for gastric diverticulum. Two of these were in the cardiac end of the stomach and these patients complained, respectively, of burning pain and epigastric fullness and of indigestion pain with blood loss. Both were completely relieved by surgery. The third patient had a prepyloric gastric diverticulum and a duodenal ulcer and the symptoms were considered to be due to the ulcer. Subtotal gastrectomy was done with the diverticulum found to consist of all three layers found in a normal gastric wall with no evidence of mucosal change or aberrant pancreatic tissue.

Differential diagnosis may be required following operative repair of a hiatus hernia, in which a contraction ring of scar tissue may remain to constrict the stomach near the cardia. Benign ulcer and ulcerated carcinoma may occasionally be confused with a diverticulum. Those diverticula near the pylorus present more of a diagnostic problem and are more frequently complicated than are diverticula near the cardiac end of the stomach.

A diverticulum may often fail to fill in the upright position and at times retained food or secretions prevent barium from entering it. It may also appear as a gas shadow adjacent to the barium filled stomach.—*A. B. Smith, M.D.*

Gianturco, Cesare, and Miller, George A. Program for the detection of colonic and rectal polyps. *J.A.M.A.*, Dec. 19, 1953, *153*, 1429–1430.

Since it is generally recognized that many cancers of the colon arise from benign adenomatous polyps, the following program was adopted by the authors: (1) High voltage roentgenography at 120 kv. is utilized. A barium suspension of one volume of powder in four volumes of water becomes transparent allowing intraluminal objects to be visible as radiolucenies at this kilovoltage. (2) Adult patients without symptoms are examined by rectoscopy just prior to the roentgenographic examination. (3) Adult patients complaining of bleeding or anal disease receive, in addition to the roentgen examination, proctosigmoidoscopy of the terminal 25 cm. This examination is performed first and the roentgen examination after proper preparation the following day.

The roentgen examination begins with fluoroscopy of the rectosigmoid area, allowing the barium to flow as far as the splenic flexure. Then two 10 by 12 inch films are exposed with the patient in two different oblique positions to assure complete visualization of the sigmoid. Following this, fluoroscopy is renewed and the remainder of the colon filled. Spot films of the colon flexures and ileum may be obtained if needed. Finally, prone and supine 14 by 17 inch roentgenograms are made with the high voltage technique. If a persistent radiolucency is found, the examination is repeated on another day for confirmation. Growths as small as 2 mm. can be ddtected.

Since this program was instituted 14 early and curable cancers of the colon were found during the course of 4,851 visual and roentgen examinations; 79, or 2.3 per cent of 3,581 patients examined roentgenologically had polyps, 40 per cent of which were less than 1 cm. in diameter. In 500 proctosigmoidoscopic examinations (patients with symptoms) 60, or 12 per cent, had polyps. Of 1,000 patients examined by rectoscopy (symptomless patients) 58, or 5.8 per cent, had polyps. As a rule, the polyps found in this group were smaller than those found by roentgen examination.—*Norman Heilbrun, M.D.*

Golden, Ross, and Morales, Pablo L. Radiological examination in organic diseases of small intestine. *J.A.M.A.*, Dec. 19, 1953, *153*, 1431–1433.

The authors review and discuss the value of the roentgenological examination in 168 cases of a total of 199 cases with verified organic disease of the jejunum and ileum. As a rule, organic disease of the small intestine will produce one or more of three symptoms which are (1) bleeding, (2) diarrhea, or (3) abdominal pain.

Three different methods of examination are utilized. (1) The small intestinal study is the routine and most practical method. A suspension of 4 oz. o barium sulfate in 5 oz. of isotonic sodium chloride solution is given by mouth after fasting overnight. Roentgenograms are obtained at half hourly intervals. Recently a nonflocculating suspension of an equal amount has been used. The films are examined immediately after processing. Fluoroscopy and spot films are done as indicated and on all cases pressure films of the terminal ileum and cecum are obtained. (2) The small intestinal enema was used in only one case. (3) When ileus is present the Miller-Abbott tube is used. The tube is passed into the intestine and samples of contents are obtained during the passage. When occult blood is found or the tube is arrested, the barium suspension may be introduced through the tube and the area at the tip or beyond may be studied fluoroscopically or with spot films.

In 133 of the 168 cases studied one or more types of examinations were done and abnormality was found in 121, or approximately 90 per cent. The incidences of findings are given in the following table.

Table I.—Number of Cases of Various Diseases of Small Intestine in Which Abnormalities Were Revealed by Roentgenography

	Regional Enteritis (64)	Tuberculosis (8)	Carcinoma (19)	Lymphoma (13)	Other Malignant Neoplasms (6)	Carcinoid (8)	Benign Tumors (15)	Totals (133)	
Abnormality not revealed.....	3	1	2	0	1	1	4	12	(10%)
Abnormality revealed.....	61	7	17	13	5	7	11	121	(90%)

The high percentage of abnormal findings emphasizes that if symptoms point to disease of the small intestine, the examination is rewarding if properly and carefully performed.—*Norman Heilbrun, M.D.*

Gynecology and Obstetrics

Whitehead, A. S. The determination of the placental site by soft-tissue radiography. *J. Faculty of Radiologists*, April, 1953, *4*, 245–263.

In this paper the author describes various techniques which have been used in roentgenological determination of the placental site, and the technique

which he has finally adopted. He also reviews various methods of investigating the placental site.

Cystography as first used by Ude, Weum and Urner in 1934 may be disadvantageous because it is generally applicable only to head presentation; it is of little value when the placenta previa is posteriorly situated, unless it extends forward between the presenting part and the bladder; it involves instrumentation of the patient; the results show a considerable margin of error. *Amniography* as proposed by Menees, Miller and Holly in 1930 has certain inherent hazards, and comparison of amniography with soft tissue roentgenography revealed no improvement in diagnostic value from the use of the contrast medium. A *selective medium* such as thorium dioxide outlines the placenta satisfactorily but is toxic to both mother and fetus. *Aortography* also outlines the placenta readily, but is too hazardous a procedure for routine use. Browne reported the use of *radioactive isotopes* (radioactive sodium) in 118 cases for placental localization with a high percentage of accuracy. *An opaque medium may be injected into the umbilical artery* in the third stage of labor to roentgenographically visualize the placental vessels, a method which has been used to investigate the location of the placenta and its mode of separation. *Calcification* occurs in the placenta and sometimes at or near term may be used as a method of determining the placental site. *Soft tissue roentgenography* for placental site localization was employed by Snow and Powell in 1934. Vaughan, Weaver and Adamson in 1942 modified this method by using a plastic opaque screen to produce a roentgenogram of even density. Reid, in 1949, recommended an aluminum filter of carefully contoured shape applied close to the anode of the roentgen tube as a method of selective absorption of radiation.

The author tried many filters in all positions relative to the anode of the roentgen tube, including various double-grid and special screen effects. He found the device which produced the most satisfactory results to be one designed as an adjustable step-wedge filter made of loose strips of aluminum. By trial and error the steps were adjusted until satisfactory filtration was achieved. The filter is held in position close to the anode by the ordinary roentgenographic cone. The patient lies on the roentgenographic table in true lateral position and the shortest possible exposure to reduce the effect of motion is made. A long focus-film distance is preferable. The author has found the best results are obtained with this wedge filter on women of average size, at or near term, using 90 kv.; 300 ma.; at 0.3 second; 40 inch focus-film distance; Potter-Bucky diaphragm; maximum coning to film size. In a routine lateral roentgenogram of the abdomen in pregnancy the structures close to the abdominal wall and the abdominal wall itself are overexposed. In order to clearly visualize both anterior and posterior structures on the same roentgenogram, the use of some device, such as the wedge filter above mentioned, is necessary. The other roentgenograms which are made without the use of the wedge filter include one in the erect lateral view of the pelvis, and in special circumstances, one each in the right and left projections of the patient's abdomen in the recumbent oblique position, and a posteroanterior or anteroposterior roentgenogram of the abdomen. If clinically permissible, the patient's bladder and rectum should be emptied before the roentgen examination.

In the lateral roentgenogram of the abdomen, as originally described by Snow and Powell, there is a black line tending to surround the limbs, trunk and head of the fetus, due to the relatively translucent subcutaneous tissue of the fetus. Amniography shows that the black line separates the fetus from the liquor amnii and the liquor amnii separates the black line from the uterine wall. External to the black line there is a homogeneous shadow which represents uterine wall, liquor, almost negligible thickness of membranes, and, where present, the placenta. In about 1 per cent of pregnancies, the placenta was found to be entirely laterally placed. Otherwise, on the lateral roentgenogram there is a unilateral thickening of the homogeneous shadow, due to the placenta. Where this unilateral thickening is not seen on the direct lateral roentgenogram due to true lateral implantation of the placenta, one oblique exposure produces the diagnostic thickening, while the other oblique roentgenogram shows the same findings as on the lateral view.

Hydramnios may render interpretation of the lateral roentgenogram difficult. It may decrease roentgenographic definition by production of additional shadows including both placental and uterine wall shadows beyond the point where a diagnostic thickening representing the placental site is apparent. It may collect eccentrically, so that no diagnostic thickening of the soft tissue shadow is seen or the thickening appears on the side opposite the placenta.

Difficulty in interpretation may be encountered in breech presentation. There are three groups of roentgenographic appearances in such presentations: (a) normal anterior or posterior "placental" shadow; (b) appearance of "placental" shadow in fundus; (c) appearance of no definite placental shadow, but the fetal head is superimposed on the placental shadow, —due to implantation of the placenta over one cornu of the uterus. In breech presentation, the visualization of both the soft tissue shadows representing uterus and liquor and of the soft parts of the breech is more difficult. The clearly differentiated fetal skull with its surrounding black line of subcutaneous tissue is replaced by the much less well defined and irregular breech. While the periphery of the uterine shadow remains relatively clear, the inner border of the "band-like" shadow normally defined by the black line around the fetal skull is not always demonstrated. The breech with or without flexed legs is only partly outlined and is relatively

poorly defined. However, in breech, as in head presentations, the presenting part normally tends to be symmetrically placed in the pelvic inlet. In transverse and oblique positions of the fetus the diagnosis of the position of the placenta will depend entirely on interpretation of the lateral roentgenogram of the abdomen.—*Samuel G. Henderson, M.D.*

Neel, J. V.; Schull, W. J.; McDonald, D. J.; Morton, N. E.; Kodani, M.; Takeshima, K.; Anderson, R. C.; Wood, J.; Brewer, R.; Wright, S.; Yamazaki, J.; Suzuki, M.; and Kitamura, S. The effect of exposure to the atomic bombs on pregnancy termination in Hiroshima and Nagasaki: preliminary report. *Science*, Nov. 6, 1953, *118*, 537–541.

This is a study during the past seven years of the potential delayed effects on pregnancy termination of exposure to the atomic bombs in Japan. The indicators utilized were: type of termination (live or stillbirth), sex of child, birth weight, and occurrence of gross congenital malformation. Each of these possible indicators of genetic damage may be influenced by a number of other factors; there are no unique yardsticks of a genetic effect. In order to render the indicators independent of one another, the first attribute considered in the analysis was the sex ratio, and the second, frequency of malformation.

The study placed the mothers and fathers into five groups, depending upon (1) their distance from the hypocenter and the calculated irradiation received, and (2) clinical manifestations of irradiation effect.

In Nagasaki, the percentage of male offspring was decreased, as should occur hypothetically following irradiation of the mother, but the more numerous Hiroshima data did not bear out this trend.

The present more extensive data likewise failed to confirm the impression of increased frequency of malformation, as suggested earlier by Bugher.

There was an increased frequency of stillbirths but analysis of the data indicated that this was a function of the mother's exposure. The significance of this is restricted because of the relationship between maternal health (in general) and certain of the indicators of genetic damage.

The variation in birth weights was not in a direction indicated by hypothesis. The expected decreased weight may have been offset by multiparity, which produces increased birth weight.

The authors felt that in view of the estimates of the radiation dosages involved, by analogy with what is now known of radiation genetics, it always has been doubtful whether significant findings attributable to the genetic effects of radiation would be apparent in the first post-bomb generation. There is no indication from this study of any "unusual" sensitivity of the human genes to irradiation.—*T. J. Wachowski, M.D.*

Borell, U., and Fernström, I. The adnexal branches of the uterine artery; an arteriographic study in human subjects. *Acta radiol.*, Dec., 1953, *40*, 561–582.

The authors investigated the diagnostic significance of the vascular patterns of the adnexal branches of the uterine artery. There was good visualization of the adnexal vessels in 69 of 171 cases in which retrograde iliac arteriography was performed. (Method described by Seldinger, S. I. *Acta radiol.*, 1953, *39*, 368; and Borell, U., *et al. Acta radiol.*, 1952, *38*, 247.) Generally, rami of the uterine artery supply the medial half of the ovary and medial two-thirds of the tube. It was usually not possible to differentiate the two branches with arteriography.

The size, course and branching of the uterine rami to the adnexa were studied in controls and pathologic conditions. In salpingitis, the rami tended to be straightened, probably from thickening of the tubal wall. Changes from controls were not marked enough to be diagnostic, however. In ovarian tumors, the course of the adnexal branch was straightened in 23 of 27 cases. The diameter of the rami in carcinoma and fibroma of the ovary varied from 2.0 to 6.0 mm. compared to an average of 1.1 mm. for controls. Often the adnexal vessels in these tumors showed branching, supplied a greater portion of the adnexa (*i.e.*, were of greater length than normal) and were associated with tumor stain.

In tubal pregnancies the ramus averaged 1.9 mm. in diameter and was nearly always branched, longer, and less tortuous than in controls. In 5 of 12 cases, characteristic smoothly arched vessels were seen running in the course of the tubal wall, and in 8 cases placental sinuses were visualized. The diagnosis of ectopic (tubal) pregnancy was thought to be possible by arteriography in a majority of cases.—*Thomas B. Efford, M.D.*

Granjon, A. La gynécographie. (Gynecography.) *Presse méd.*, Dec. 25, 1953, *61*, 1764–1766.

The procedure consists of roentgenography of the female organs after induction of pneumoperitoneum. Reference is made to the original work of Stein and Arens (of Chicago), who introduced a special table for this purpose, yet it is stressed that conventional equipment will suffice in most cases.

This examination should not be performed in infectious processes involving the peritoneum, and the menstrual period is to be avoided, though otherwise bleeding per se is not a contraindication, nor are tubal pregnancy with hematosalpinx, or tubal infection. The patient is prepared by adequate cleansing of the bowels, and receives psychological, and, if necessary, chemical sedation. In one session, 1,500–1,800 cc. of air are insufflated through a trocar piercing the abdominal wall. The tubes could also be

used for this purpose (extended Rubin test), but this is seldom recommended.

The roentgenograms are taken in prone Trendelenburg position (30–35°) with the vertical beam of a rotating anode centered over the coccyx. The built-in Bucky grid is used with 200 ma., 60 kv., at one second exposure. Hysterosalpingography may be performed at the same time, resulting in "complete" gynecography.

Excellent visualization of the uterus is obtained, which allows the demonstration of hypoplasia or other deformities, as well as fibromas. The tubes appear well outlined, and sometimes extrauterine pregnancy may be diagnosed. However, the main value of the method lies in the study of size, shape, and position of the ovaries, providing at the same time documentary evidence for future comparison. It is also the best method for determining the connections of a pelvic mass.—*E. R. N. Grigg, M.D.*

Genitourinary System

Duff, John, Kenyon, Herbert R., and Hyman, Richard M. Pyelography in combination with simultaneous retroperitoneal pneumography. *J. Urol.*, Dec., 1953, *70*, 963–968.

The diagnosis of renal and retroperitoneal disease can be greatly facilitated by the use of combined pyelography and retroperitoneal pneumography. The opaque medium renders visible the excretory passages of the urinary tract and the oxygen outlines the renal parenchymal and other retroperitoneal soft tissue structures.

The technique employed by the authors utilizes the retrorectal approach. The patient is placed in the knee-chest position and under sterile precautions, a spinal needle is introduced along the sacrum, just missing the bony edge at the anterior aspect of the inferior border of the sacrum. The direction of the needle is medial, posterior and cephalad, following the anterior sacral curve. Penetration to 3 to 4 cm. depth brings the needle tip well within the retrorectal space. A 50 cc. Luer syringe with a three way stopcock is connected with a source of oxygen. The first 50 cc. of oxygen is injected slowly. The operator should be cognizant of a certain amount of resistance as the syringe is emptied, but actual forceful pressure should not be necessary and a lack of resistance may indicate improper positioning of the needle point. In the average adult, 1,250 cc. of oxygen is the optimum amount to be injected. When the needle is withdrawn the patient assumes a sitting position, flexing the trunk several times before the films are exposed. Following this an immediate urogram is done either by the retrograde or intravenous method.

In normal individuals clear renal outlines are usually obtained bilaterally. With the technique used, the authors believe that failure of gaseous diffusion is significant and may indicate a congenital defect, inflammatory or neoplastic invasion.—*George W. Chamberlin, M.D.*

Petković, S. Urographie bei den in die Harnblase penetrierenden Sigma- und Rectumtumoren. (Urography in tumors of the sigmoid colon and rectum penetrating into the bladder.) *Chirurg*, Dec., 1953, *24*, 532–535.

The author reviews the roentgenological findings after intravenous pyelography in 9 cases of carcinoma of the rectum and sigmoid and 1 case of tuberculosis of the sigmoid with bladder invasion. In 6 cases, no abnormality was noted; in 3, dilatation of the ureters was found, and in 2, compression of the bladder.

Cystoscopy and chromocystography were also used.

Four urograms are reproduced, illustrating the above mentioned findings.—*Karol E. Matzinger, M.D.*

Salvati, Rino. Ancora sulla urografia intramuscolare con jaluronidasi; indicazioni e limiti. (Intramuscular urography with hyaluronidase; indications and limitations.) *Ann. radiol. diag.*, 1953, *26*, 153–160.

The combination of hyaluronidase with intramuscular urography increases the chances of obtaining satisfactory urograms, especially in babies and in adults in whom intravenous injection is difficult or impossible. This procedure permits rapid absorption of the contrast medium, thus resulting in greater concentration in the urine to give satisfactory excretory studies.

The method was used in cases of azotemia and in patients having only one functioning kidney. Intramuscular injection of the contrast medium, being more slowly absorbed than by the intravenous method, puts less strain on a damaged or overburdened kidney. In heavy patients, 70 per cent rather than the 30 per cent iodine compound is used, diluted with an equal part of distilled water. A preliminary injection of hyaluronidase with novocaine 1 per cent is made deep in the muscle of the gluteal region. Changing the syringe without removing the needle, the contrast substance is injected. The same procedure is carried out in the opposite gluteal region and films are exposed at 15–30–45 minute intervals. The examination may be performed on ambulatory cases.

The contraindications are the same as for intravenous urography.—*Peter E. Russo, M.D.*

Bonetta, Camillo. L'urografia per via intramuscolare con la jaluronidasi nei bambini. (Intramuscular urography with hyaluronidase in children.) *Ann. radiol. diag.*, 1953, *26*, 223–242.

Urography in infants has always presented the difficulty, of introducing the contrast substance into the blood stream. Although intramuscular injection has been used with satisfactory results, the addition of hyaluronidase has decreased the pain associated with this procedure and has improved the diagnostic aspects of the examination. The more rapid diffusion and absorption of the contrast substance are of definite advantage.

The author carried out this examination in about 30 cases. Several of these are cited in the article accompanied by illustrations. A concentration of 30 per cent iodine contrast medium was used. The procedure caused very little discomfort to the patient and no ill effects, either local or general, have been observed. Exposures at 10–15 and 30 minutes were made to visualize the excretion of the contrast substance by the kidneys.

The author highly recommends this procedure in children for pyelography.—*Peter E. Russo, M.D.*

Petkovic, Sava. Le rein muet à l'urographie et l'urétérocolostomie. (The urographically silent kidney and ureterocolostomy.) *J. d'urol.*, 1953, *59*, 338–344.

The problems involving the silent, nonfunctioning kidney, especially in the presence of infiltrating tumors of the bladder, are discussed. The author bases his study on 14 out of 53 cases of bladder tumors in which he performed bilateral ureterocolostomy in 5 cases, nephrostomy or cutaneous ureterostomy in 8 cases and vaginal cystectomy (Coffey 11) in 1 case.

The complications following the transplantation of the ureters into the intestines are numerous. Azotemia, in the postoperative period, is more marked than after the other interventions. The possibility of an ascending infection has special importance in the case of dilated ureters with rigid walls draining a kidney with great alteration of its function. The motility of the ureter is impaired and antibiotics are of no help in a nonfunctioning kidney with a resulting pyelitis. In the postoperative period one may expect, in addition, uremia, metabolic disturbance of the salts and water, paralytic ileus and bronchopneumonia, all of which may endanger the life of the patient. Jacobs and Stirling showed in statistics of 1,673 cases that in a normally functioning kidney the metabolism of salt and water was impaired in 11.6 per cent, while in kidneys with altered function the rate was 41.9 to 46.5 per cent. Crevy and Reiser likewise found that this trouble occurred two and one-half times more frequently in the cases in which the urogram showed functional alteration of the kidneys. The mortality was much higher when ureterocolostomy was performed in cases with neoplasms of the bladder, having kidneys with altered function.

It appears that one might as well sacrifice the nonfunctioning kidney to avoid these postoperative complications. On the other hand, one is justified in the consideration of the cutaneous ureterostomy of the side which does not function after the intravenous injection of the opaque medium.

Temporary nephrostomy of the nonfunctioning kidney offers the following advantages: The surgeon can inspect the kidney and its pelvis and judge the advisability of saving it. Retrograde roentgen examination may be carried out through the drain of the nephrostomy. Drainage of the kidney involved in the pyelonephritis will improve its condition. A bilateral ureterocolostomy can be performed at the time of the nephrostomy. If the good kidney becomes affected in its function because of edema of the implanted ureter, the nephrostomized kidney, in some instances, recovers its function sufficiently to support the patient for a few days. In 3 of the author's cases the nephrostomy contributed to a functional recovery of the nonfunctioning kidney.

The advantages of cutaneous ureterostomy if performed on the nonfunctioning side are: The outside drainage of the infection of the dilated urinary tract which affords facilities for direct irrigation; the avoidance of ascending infection from the intestines. In the immediate postoperative period the advantages are similar to those enumerated for nephrostomy. In the ensuing months, as the functioning kidney regains its full function, the function of the kidney with the cutaneous ureterostomy diminishes and when the drain is removed the cutaneous opening becomes obliterated. Exceptionally, the kidney's function recovers completely and a ureterocolostomy may be considered at a later date.

In conclusion, the author emphasizes the necessity of abstaining from ureterocolostomy of the nonfunctioning kidney in tumors of the bladder and substituting temporary nephrostomy or cutaneous ureterostomy.—*S. Silvera, M.D.*

Boyce, William, H., Harris, James A., and Vest, Samuel A. The dorsal cystogram or "squat shot:" a technique for roentgenography of posterior bladder and pelvic ureters. *J. Urol.*, Dec., 1953, *70*, 969–974.

The authors use 15 per cent sodium iodide as a contrast medium. Approximately 250 cc. is instilled into the bladder. The patient is then put in a sitting position on the roentgenographic table with the trunk flexed and arms extended to the ankles. This is a position which has previously been described for roentgenography of the rectum and pelvic colon as well as for measurements of the female pelvis. The film is exposed with the central ray directed through the center of the patient's pelvis.

According to the authors, this is the most valuable single survey film of the cystographic study. In their series of 43 patients with generalized or specific pathological conditions of the bladder, the dorsal cystogram gave evidence of a pathological change in 100 per cent of the cases. For further studies, the rou-

tine anteroposterior and oblique projections were also used, then a urethrocystogram was made on voiding. In addition to demonstrating defects in the contour of the bladder wall, this position may show abnormal reflux in the ureters because of the increased pressure on the bladder, consequent to the squatting posture.—*George W. Chamberlin, M.D.*

Forbes, Kenneth A., and Cordonnier, Justin J. Circulatory collapse following combined use of Rayopake and air for urethrocystography. *J. Urol.*, Dec., 1953, *70*, 975–979.

The patient, a sixty year old male, had an unusual congenital membrane of the anterior urethra about 2 cm. distal to the external sphincter. Cystocopic examination also revealed a chronically inflamed bladder with a fungating mass on the left posterolateral bladder wall, biopsy of which showed inflammatory tissue. The cystourethrogram was done after the injection of 150 cc. of air into the bladder and 30 cc. of rayopake into the urethra. After two films had been exposed in the anteroposterior and oblique projection, the patient complained of urethral burning, vertigo and his face and neck became flushed. This was followed by coughing and expectoration and then a period of apnea for thirty seconds, after which irregular, labored respirations were noted. He then developed cyanosis and had a generalized clonic convulsion. The blood pressure was unobtainable and no pulse could be palpated. The patient was given 1 cc. of 1 to 1,000 epinephrine and 50 mg. of ephedrine, intramuscularly, and intravenous injection of 10 per cent glucose in water was started immediately. Following this he was also given 750 cc. of plasma and 10 mg. of neosynephrine. The pulse and blood pressure returned and supportive therapy was carried out for an additional six hours before his vital signs were stabilized. His urinary output remained low for twenty-four hours and for several days he was lethargic and confused.

The exact cause of the shock-like condition following the diagnostic urethrocystogram could not be determined. The possibility of an anaphylactoid reaction to the iodine containing compound or air embolism was considered. The patient gave no personal or family history of previous allergy and had previously tolerated intravenous diodrast without reaction. Skin tests for iodine sensitivity with rayopake, diodrast and skiodan were all negative. The clinical features of air embolism closely resemble those seen in anaphylactoid reactions, a shock-like state may occur with loss of sphincter control, vomiting, convulsions, lethargy and cerebral anoxia.

In view of their experience, the authors feel that the introduction of air into the urethra and bladder for any purpose should be abandoned, and that caution is necessary when injecting an iodine compound into the urethra in the presence of an obstructive lesion.—*George W. Chamberlin, M.D.*

Higgins, Charles C. Nonopaque urinary tract calculi. *J. Urol.*, Dec., 1953, *70*, 857–863.

The term "nonopaque stone" as applied to calculus disease of the urinary tract is not strictly accurate and has been used unscientifically.

Two types of urinary calculi are known to exist: (1) the pure calculus; (2) the mixed calculus. Pure calculi are rare and most so-called purestones are composed of only 90 to 95 per cent of one crystalloid. The purest of urinary calculi are the uric acid, cystine and xanthine stones. While pure oxalate stones do occur, they often contain other crystalloids such as uric acid and phosphates. A pure phosphatic calculus is unusual. The mixed calculi can be divided into two groups: (1) those in which the precipitation of the different salts has occurred simultaneously, producing a diffuse density; and (2) those in which the precipitation of the salts has occurred at different times, producing a laminated calculus.

The relative opacity of a urinary calculus will depend upon the amount and distribution of its calcium content, its size and thickness, and the relative density of the soft tissues of the abdomen and other superimposed shadows. It is generally considered that renal and ureteral calculi are easier to detect on the roentgenograms then are vesical calculi. The roentgen diagnosis can usually be made on the basis of stereoscopic abdominal films and an excretory urogram. Opaque pyelograms may obscure a calculus of low density. In such instances, an air pyelogram is usually advisable and when properly done is a safe procedure.—*George W. Chamberlin, M.D.*

Presman, David. The symptomatology and management of prostatic calculi. *Surg., Gynec. & Obst.*, Nov., 1953, *97*, 608–618.

The pathogenesis and symptomatology of prostatic calculi were fully described in 1861, but their frequency and importance were not recognized until recently.

Forty-six cases of true prostatic calculi and 2 cases of false prostatic calculi were analyzed by the author.

True or endogenous calculi develop within the prostatic gland for the most part after the age of fifty. Other associated pathology of the prostate was found in 78 per cent of the cases. It was felt that symptomatology was usually a reflection of the associated disease (prostatitis, benign hypertrophy, carcinoma) for most patients were asymptomatic if none was present.

Plain roentgenograms of the prostatic region are recommended in all cases with prostatic symptoms for reliable diagnosis, since calculi are rarely found on rectal examination.

Therapy was instituted primarily for associated

pathology. Surgery was done if the calculi were large or numerous.

False or exogenous calculi form in the prostatic urethra and symptoms are usually those of bladder-neck obstruction. Surgery was required in both cases presented. The calculi in one case developed following prostatectomy, the second case had had no previous surgery.—*George A. Miller, M.D.*

Garrett, Robert A., and Mertz, H. O. Wilms's tumor in children. *J. Urol.*, Nov., 1953, *70*, 694–703.

The authors review briefly the histogenesis, symptomatology and diagnosis of Wilms's tumor.

Their series includes 23 patients with this disease. The survival rate for all cases in this series is 34.8 per cent after two years.

The therapy should be individualized. Early nephrectomy in the smaller lesions is recommended. Preoperative irradiation to reduce tumors to operable size, nephrectomy and postoperative irradiation are used for the larger lesions. In a few instances the patients have had satisfactory palliative response to radiation therapy for the metastatic lesions of Wilms's tumor.—*George W. Chamberlin, M.D.*

Krieger, Harvey, Abbott, William E., Levey, Stanley, and Babb, Louis. Bilateral total adrenalectomy in patients with metastatic carcinoma. *Surg., Gynec. & Obst.*, Nov., 1953, *97*, 569–572.

Metabolic data obtained following bilateral adrenalectomy in 5 cases of metastatic carcinoma (3 carcinomas of the breast, 1 carcinoma of the prostate, and 1 melanosarcoma) are presented.

Both adrenals were removed simultaneously with two teams doing the surgery. Operative time was usually about one hour. A detailed report is given on preoperative and postoperative care in this type of patient including substitution therapy with cortisone. Profound metabolic changes following surgery quickly returned to normal under adequate therapy.

The study indicated that subjective improvement did occur in the breast cases for varying periods of time. Disappearance of hypercalcemia and negative calcium balance were the best objective signs.

No alteration in the clinical course of the case with melanosarcoma was detected.—*George A. Miller, M.D.*

Nervous System

Svien, Hendrick J., Price, Richard D., and Bayrd, Edwin D. Neurosurgical treatment of compression of the spinal cord caused by myeloma. *J.A.M.A.*, Oct. 31, 1953, *153*, 784–786.

Seven patients with myeloma (4 with solitary and 3 with multiple lesions) producing compression of the spinal cord were operated on, at which time laminectomy and decompression of the spinal cord were carried out. This was done in the Section on Neurologic Surgery of the Mayo Clinic between 1930 and 1950. During this period 524 patients with myeloma were seen, of whom 31 (6 per cent) were paraplegic when examined.

The lesions causing cord compression were most frequent in the thoracic vertebrae, only 1 of the 7 patients having a lesion in the lumbar spine (first lumbar vertebra). One patient with a solitary lesion in the eighth thoracic vertebra at the time of surgery was found four years later to have multiple leisons and Bence-Jones proteinuria.

Gratifying results were obtained in 4 cases: 2 with solitary and 2 with multiple lesions. Diagnosis in all cases was made postoperatively.

The authors conclude that all patients with compression of the spinal cord as a result of myeloma, either solitary or multiple, should have palliative surgery.—*Walter T. Hileman, M.D.*

Wycis, H. T. Lipoma of the spinal cord associated with Klippel-Feil syndrome. *J. Neurosurg.*, Nov., 1953, *10*, 675–678.

The case of a forty-eight year old female exhibiting fusion of multiple cervical vertebral segments in association with an extensive intramedullary lipoma involving the cervical cord is reported from the Temple University Hospital in Philadelphia. In addition to the fusion there was definite widening of the spinal canal partially at the expense of the vertebral bodies. Myelography demonstrated a partial block at the cervicothoracic level with characteristic signs of a large space occupying mass above this. At operation, a good portion of the cervical cord was found to be destroyed with the remnant forming a thin shell about the tumor. In spite of this, the patient made some neurologic recovery and has remained relatively stable over a four year period of observation.

It is suggested on the basis of this and other case reports that the Klippel-Feil syndrome may represent a dual anomaly involving both skeletal and neurogenic tissues.—*James A. Martin, M.D.*

Skeletal System

Mitchell, John. Cough fracture. *Med. Illustrated*, Sept., 1953, *7*, 673–676.

This discussion concerns the author's experience with cough fracture as a not infrequent complication of pleurisy.

Cough fracture has been noted during the past few decades in a variety of pathological conditions. Nevertheless, many cases have occurred in healthy young adults, apart from a temporary cough. Pain along the intercostal nerves aggravated by cough on deep breathing is a common complaint. In cough fracture, a vigorous cough always precedes the onset

of pain and the tickling cough of an acute upper respiratory infection is a very common cause. Pain often comes on gradually, usually lasting one to three months, and is relieved by chest strapping. Commonly, pain is referred to the anterior axillary area of the segment involved.

The fracture usually occurs just in front of the origin of the serratus anterior or just behind the origin of the external oblique. Roentgenographically, not more than a fine crack is seen after the accident and may not be detected until a two month follow-up roentgenogram reveals evidence of callus formation. Additional anterior oblique roentgenograms may be necessary.—*Paul C. Harding, M.D.*

Shapiro, Richard D., Bernstein, William H., and Berman, T. M. Melorheostosis Léri; report of a case and a brief review of literature. *South. M. J.*, Nov., 1953, *46*, 1102–1104.

To the approximately 50 cases of melorheostosis Léri reported in the literature is added another, that of a forty-five year old white female exhibiting characteristic lesions in the left scapula and humerus. These had been present and slowly progressing for sixteen years. Symptoms were constant dull aching pain, without swelling or restriction of motion.

The roentgenogram showed dense cortical and subperiosteal hyperostosis with sharp dense undulating margins on the lower inner aspect of the humerus. There was slight endosteal projection of the dense bone into the medullary canal, and multiple cortical densities were present on the opposite side of the midshaft of the humerus. Scattered very dense lesions were also present in the acromion and coracoid scapular processes. At operation the bony lesions were too dense and indurated for successful biopsy.

It is thought by Putti that the lesions follow localized decreased blood supply to the bone involved, resulting in local asphyxia with resultant fibrosis and fibrous replacement. The disease is always slowly progressive and chronic. No malignant degeneration is known to have occurred.—*Walter T. Hileman, M.D.*

Liess, G., and Dörffel, E. Röntgenologische Studie zur Knochenstruktur bei der Albers-Schönbergschen Erkrankung. (Roentgen study about the bony structures in Albers-Schönberg disease.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1953, *79*, 713–727.

Four cases of Albers-Schönberg disease are added to the literature which contains about 100 such case reports.

Roentgenologically two different factors seem to cause the bone sclerosis. One is the disturbance of enchondral ossification characterized by parallel bands of increased density; occasionally, longitudinal bands are due to the same process. The other factor is the endosteal hyperostosis, leading to a diffuse sclerosis of the spongiosa, compacta and medulla. Dense bands and metaphyseal widening are not seen in this form.

Pathologically both forms show an excess of bone apposition and disturbed bone resorption. The lack of normal bone resorption or its diminution explains the increased bone formation.

The clinical behavior varies in the two forms. The classical Albers-Schönberg disease indicates a rather poor prognosis and exhibits the clinical signs of optic atrophy and anemia. The second form is familial and clinically without symptoms; its prognosis is good.

The difference is so striking clinically and roentgenologically that the authors propose for the second form the name familial diffuse osteosclerosis (first described by Harnapp).—*Hans W. Hefke, M.D.*

Kastert, J. Zur Röntgendiagnostik des Knochenherdes (Ausschöpfung alter und neuer Untersuchungsmethoden). (Roentgen diagnosis of the osseous tuberculous focus; evaluation of the older and newer methods of examination.) *Tuberculosearzt*, Dec., 1953, *7*, 734–740.

The author uses both ordinary roentgenography and laminagraphy. He found laminagraphy particularly of value in determining extension of the destructive process. Haziness of the contours was the main finding. A sharply defined, fairly wide, well calcified contour of a focus was associated with healing. The relationship of a focus located close to a joint to the joint surfaces could be demonstrated better by laminagrams than by ordinary roentgenograms—*Karol E. Matzinger, M.D.*

Miall, W. E., Caplan, Anthony, Cochrane, A. L., Kilpatrick, G. S., and Oldham, P. D. An epidemiological study of rheumatoid arthritis associated with characteristic chest x-ray appearances in coal-workers. *Brit. M. J.*, Dec. 5, 1953, *2*, 1231–1236.

A syndrome in which rheumatoid arthritis is associated with characteristic chest roentgen findings in coal-workers distinguishable from massive fibrosis appearing in complicated pneumoconiosis is described. It consists of rapidly developing numerous discrete rounded opacities scattered diffusely and appearing in crops. The lesions in each crop are similar in size and rate of development.

The epidemiological investigation was done on miners or ex-miners in a South Wales mining valley where over 95 per cent of the population had been roentgenographed.

A positive diagnosis of rheumatoid arthritis was based on a typical history of polyarthritis, character-

istic roentgen appearances and positive differential agglutination tests. The prevalence of rheumatoid arthritis among cases with these characteristic chest findings is over 50 per cent; among cases of massive fibrosis the figure is 3 per cent. No similar lesions were found in two similar groups of miners with and without simple pneumoconiosis.

The possible etiology of this lesion is discussed; from the available evidence, it appears similar to massive fibrosis. It is postulated that there may be a particular type of tissue reaction to dust and tuberculosis in the lungs of miners predisposed to the development of rheumatoid arthritis.—*P. B. Parsons, M.D.*

Broder, Harold. The late results in Legg-Perthes' disease and factors influencing them: a study of one hundred and two cases. *Bull. Hosp. Joint Dis.*, Oct., 1953, *14*, 194–216.

One hundred and two cases of Legg-Perthes' disease were studied with the aim of obtaining data of prognostic significance that could be used to reduce the prolonged treatment time. The case material was divided into: (A) analysis of vital statistics; (B) statistical analysis of history and physical findings; (C) evaluation of relationship between factors such as duration of symptoms before treatment was begun, stages of the disease when treatment was instituted, type of involvement, age, sex, and treatment; (D) evaluation of data obtained in a follow-up study of 40 cases.

(A) 80.4 per cent of the cases occurred between the ages of four to nine years, with males predominating 4 to 1. Bilateral involvement occurred in 6.8 per cent.

(B) The presenting symptoms in 81.3 per cent were either limp or hip pain or a combination of both. Others had various combinations of knee pain, limp and thigh pain. The absence of hip pain does not rule out the disease. One case was asymptomatic; 81 cases had some motion restriction, which was usually overcome by the time healing had taken place. Those left with restricted motion showed severe deformity roentgenographically.

(C) 80 per cent of the cases with symptoms of less than three months showed early or very early changes. The chances of obtaining good or excellent late results with conservative therapy were best when the roentgenograms showed the involvement to be early or very early. The further the case had advanced when first seen, the worse were the late results. The degree of involvement of the femoral head and neck varied, but it could be placed into two general groups of prognostic significance: (1) mild involvement, and (2) severe involvement. Two-thirds of the cases were mild and one-third severe The cases of mild involvement obtained much better results. The younger patients had milder involvement; 80 per cent of the cases under age five had excellent or good results.

Conservative treatment was used in all but 16 cases. Ten cases were operated upon and 6 were not treated. The latter 6 cases progressed to greater deformity. Conservative treatment tended to modify the progression of the deformity and in general made it less. The severity of involvement was found to be the most important determining factor in the production of deformity. The physician has no control over this factor. Conservative treatment consisted of non-ambulation or ambulatory non-weight bearing, or a combination of both. Deformity usually did not progress after the fairly well regenerated stage.

(D) In the patients followed up to nine years, only minimal limp and minimal restriction of motion was found in the majority of cases which had less than excellent or good results. Three patients in the group followed ten to fourteen years with good restitution limped, had restricted motion and shortening. One patient with fair restitution and 1 with good restitution had early osteoarthritic changes. Those patients in the twenty year group, which included 2 fair and 1 poor restitution, had fairly advanced hypertrophic osteoarthropathy.

The following conclusions are drawn: (1) the severity of involvement before treatment can be used to predict the final result; (2) some form of non-weight bearing is needed to obtain good results; (3) bed rest has been generally overdone and ambulatory non-weight bearing could possibly be used in the milder cases; (4) deformity rarely increases with weight bearing if the femoral head and neck are fairly well regenerated; (5) the future function of the involved hip depends upon the residual deformity. Patients who have excellent restoration of the femoral head and neck will usually have a trouble-free joint. Those with a lesser degree of restoration will almost always develop trouble with the joint.—*Charles W. Cooley, M D.*

Milch, Henry. Ischial apophysiolysis: a new syndrome. *Bull. Hosp. Joint Dis.*, Oct., 1953, *14*, 188–193.

Ischial apophysiolysis can be classified as a specific syndrome, based on a pathognomonic sequence of events. There is a common traumatic etiology, characteristic clinical and roentgenological findings, and a constant pathomechanics.

Trauma appears to be the only necessary factor in the pathogenicity of the syndrome The onset occurs between the ages of twelve to twenty-five years when the ischial apophysis develops and unites. It occurs mostly in males and on the left side. Occasionally it is bilateral.

Clinically there is a sudden severe pain in the buttock of the affected side. This is alleviated by rest and aggravated by exercise. There is pain on pressure

over the tuberosity and limitation of motion of the extended leg when the thigh is flexed.

Roentgenograms are diagnostic of the condition and show the avulsed apophysis to lie below or lateral to the body of the ischium. The early cases must be differentiated from a peri-ischial calcification, Ewing's tumor, tuberculous or pyogenic osteomyelitis. The clinical course is of value here. Late cases may show the apophysis to be lunate in shape, fragmented and appear to be uniting with the body of the ischium.

The insertion of the hamstring muscles to the ischial tuberosity provides the basis for the condition. Undue stress on the hamstrings produces a shearing force on the apophysis resulting in the avulsion. The sacrotuberous ligaments are severely lacerated if there is excessive downward displacement of the apophysis, as they tend to prevent this if they are intact.

Treatment depends on the degree of separation and the duration. Rest and avoidance of strenuous activity are effective when there is minimal separation. The patient need not be confined to bed. Surgical attempts at reattachment of the apophysis in those that are widely separated do not seem justified in view of the results in the few cases that have been reported. Excision of the apophysis and attachment of the hamstring muscles to the body of the ischium is used when there is constant pain and the time interval is so long that a non-union may be expected.—*Charles W. Cooley, M.D.*

Landoff, Gustaf-Adolf. Vertebral fractures in insured and uninsured patients; analysis of the frequency and duration of symptoms, convalescence and disability. *Acta orthop. Scandinav.*, Suppl. xiii, 1953, 5–67.

The author has selected 154 cases out of a group of 294 patients for analysis. All of these had fractures of the thoracic or lumbar vertebrae. Cases with paraplegia and fractures of the cervical spine were not included in the survey. The main purpose of the survey was to compare series of fractures of the vertebrae in two groups, one group consisting of those who had adequate insurance coverage and the other of those persons who did not have insurance.

The analysis was done very carefully, and multiple tables and charts are included in a 60 page monograph. The study showed statistically that the percentage of individuals claiming residual symptoms and disability was higher in the insured group.

Many other rather interesting conclusions are drawn. The author states that deforming spondylosis is an aging process and he believes there is no evidence to show that it can be caused by fractures of the vertebra. He is convinced that there is no relationship between the degree of kyphosis or scoliosis and the frequency of symptoms or disability. He found that the frequency of residual symptoms was about the same in patients with arthritic changes as in those without arthritic changes.—*R. E. Kinzer, M.D.*

Vilaseca, J. M., Barceló, P., and Casademont, M. Neartrosis interespinosa. (Interspinous neoarthrosis.) *Acta iber. radiol. cancerol.*, July–Sept., 1953, *2*, 257–270.

Report of the first methodical study of arthrosis of the lumbar posterior spinous processes was made by Baastrup before the Fourth International Congress of Radiology at Zurich in 1934. Baastrup gave prior credit to Zollinger, Brailsford, Mennell, Simon, Schmorl and Junghanns, who had made reports on the subject.

Interspinous neoarthrosis occurs principally in females (77 per cent), showing up during or after the climacteric. The condition is often associated with other involvement of the intervertebral structures of traumatic and/or degenerative nature, all associated with exaggeration of the normal lumbar lordosis. Favoring factors are obesity, deviations of the vertebral axis, lumbosacral anomalies and especially excessive size and approximation of the posterior spinous processes. Baastrup's disease as a genuine arthrosis of the spinous processes has its unquestionable individuality as a cause of stubborn lumbago, but it is clinically infrequent. Because of evident signs of arthritic degeneration in other situations, the the authors are loath to admit this lesion as the direct and exclusive cause of lumbago.

The authors present a number of very interesting and highly instructive roentgenographic reproductions and line drawings.—*James T. Case, M.D.*

Latimer, F. R., Webster, J. E., and Gurdjian, E. S. Osteitis deformans with spinal cord compression; report of three cases. *J. Neurosurg.*, Nov., 1953, *10*, 583–589.

Osteitis deformans with spinal cord compression is a relatively rare disease. By considering encroachment on the spinal cord only if a myelographic block was demonstrated or only if the pathologic process had been verified by surgery or autopsy, the authors found 22 similar cases in the literature.

The symptoms of the 3 patients reported were due to progressive spinal cord involvement. Case i, a sixty-six year old white male, was ambulatory with a "steppage" gait while Case ii, a sixty-five year old white male, was bedridden with complete paraplegia. Case iii, a thirty-four year old white male, had had progressive weakness of both legs six months prior to admission to the hospital.

Roentgenograms demonstrated that involvement in all 3 patients was of the polyostotic variety, and myelography revealed a complete block of the sub-

arachnoid space in the mid-dorsal region in each of the 3 patients.

The results of laminectomy were gratifying in 2 of the 3 cases. Case I was afforded symptomatic relief for one year. Case II, initially the most severely affected, was able to resume nearly normal activity (within six months he was playing golf) for a period of six years before relapsing. Following a second decompression, this patient was again improving. Case III obtained only temporary benefit and was confined to a wheelchair by weakness of the lower extremities.

The authors conclude that all patients with osteitis deformans manifesting signs of spinal cord involvement should be subjected to myelography and that a block of the subarachnoid space, if present, should be relieved by adequate laminectomy. They further state that the severity of the neurological deficit should not be regarded as a reliable guide as to the ultimate benefit from surgery.—*William H. Smith, M.D.*

Bürger, M., and Schulze, W. Osteoarthropathia und Osteoporosis alcaptonurica. (Alcaptonuric osteoarthropathy and osteoporosis.) *Deutsche Ztschr. Verdauungskr.*, April, 1953, *13*, 49–56.

Alcaptonuria, a hereditary metabolic disorder, has formerly been of theoretical interest only, but has received renewed attention since secondary ochronotic deposits and calcifications have been discovered in fibrocartilage, especially of joints. An associated chronic acidosis is caused by life-long flooding of the body with homogentisic acid, which is an intermediary product of the protein metabolism. This chronic acidosis is held responsible for the calcium deposits in cartilage and for associated osteoporosis and osteoarthritis, the latter being called osteoarthropathy by the authors.

Two cases are briefly reported and well illustrated, the first a male, aged fifty-seven, the second a female, aged forty-three; both had only minimal pain in the back. Calcifications and associated osteoporosis and osteoarthritis were found in the intervertebral discs and peripheral joints, and there were also calcium deposits in the pubic symphysis, costal cartilages and the ear lobes. Dark pigmentations of sclerae near the corneal limbus were seen in the first case. These must be differentiated from melanosarcoma. Otherwise, the affected eye may become the victim of an enucleation. Lack of sufficient experience in this respect is said to have led to such tragic result in the past.—*Ernest Kraft, M.D.*

Dent, R. V., Milne, M. D., Roussak, N. J., and Steiner, G. Abdominal topography in relation to senile osteoporosis of the spine. *Brit. M. J.*, Nov. 14, 1953, *2*, 1082–1084.

This article records the results of measurement between the subcostal and suprailiac lines and the ratio of this measurement to the height of the patient in 152 male and 188 female subjects, all chronic patients in the hospital having an average age of sixty-eight years.

In the comparison of roentgenograms of the cases having an abnormally low pelvi-costal ratio with those of the controls, no significant difference was found in the lengths of the lumbar spines, in the amount of lumbar lordosis, or in the thickness of intervertebral discs. There was, however, a clear difference in the obliquity of the ribs in the two groups.

There was a significantly greater degree of osteoporosis as measured by biconcavity of lumbar vertebrae in the cases.—*V. L. Peterson, M.D.*

Wilson, Donald. A study of spinal osteoporosis. *Proc. Roy. Soc. Med.*, Nov., 1953, *46*, 977–981.

The author reviews 36 cases of spinal osteoporosis. He divides these cases into two major groups: the first group (15 cases) had either a high alkaline phosphatase blood level, a history of injury or associated disease, or a benign tumor of bone; the second group (21 cases) had no such history and the blood chemistry was normal.

In the first group 8 patients had a high alkaline phosphatase of which 4 revealed Bence-Jones protein indicative of myelomatosis, 2 had metastases, 2 had Paget's disease, and 2 showed widespread decalcification due to associated disorders such as renal dystrophy.

In the second group of patients 19 of 21 were women, as contrasted to the first group in which only 5 of the 15 were women. The most common etiologic factors in this group were: menopausal osteoporosis either natural or artificially induced, and a diet deficient in calcium and first class proteins. The former was found to be the commonest of all types of spinal osteoporosis.

The author discusses the treatment of this condition and emphasizes the danger of spinal bracing for the relief of pain because of the subsequent furthering of osteoporosis.—*Denis V. Campbell, M.D.*

Mygind, H. B. The accessory tarsal scaphoid; clinical features and treatment. *Acta orthop. Scandinav.*, 1953, *23*, 142–151.

The author reports his observations on 173 patients who presented themselves complaining of local pain in the arch of either foot and who on roentgenographic examination exhibited an accessory tarsal scaphoid bone. Eighty-two per cent of the cases were female; in 90 per cent the anomaly was bilateral; 80 per cent were between eleven and fifteen years of age.

The anomalous bone was oval in 30 per cent, triangular with base adjacent to the tuberosity of the scaphoid in 60 per cent, and fragmented in 10 per cent. The tendon of the tibialis posterior muscle in-

variably surrounded the bone and some fibers were usually attached.

The patients complained of pain and tenderness over the arch of the foot. The foot was usually in slight valgus and a bunion had developed over the bony prominence. The skin was reddened and thickened. Pain was localized to the area, was worse during weight-bearing and walking and could be elicited on pressure from the arch toward the accessory bone in the dorsal direction as well as by pronation or supination of the foot.

Malacic changes, consisting of translucent patches in the adjacent portions of the accessory and the scaphoid bone, were demonstrated roentgenographically in the young patients. In the older group, trauma was thought to be the etiologic factor. Definite tear of the syndesmosis between the two bones was demonstrated.

Follow-up examination in a small number of the young group showed eventual fusion of the accessory bone to the tuberosity of the scaphoid resulting in a cornuate scaphoid.

Treatment was conservative in 96 cases and consisted mainly of arch supports. The surgical approach was operative removal of the accessory bone and the adjacent tuberosity of the scaphoid.

The author concludes that an accessory tarsal scaphoid gives rise to mild symptoms during the period of growth, mainly in young girls. The symptoms are transitory and operation is neither required nor advisable. In older patients, the symptoms are usually traumatic in origin, and surgical removal is indicated only after conservative measures have proved ineffective.—*Robert E. Flynn, M.D.*

Trueta, Joseph. The influence of the blood supply in controlling bone growth. *Bull. Hosp. Joint Dis.*, Oct., 1953, *14*, 147–157.

The inequality in length of limbs, and especially the lower limbs, has been a subject of considerable interest to the medical profession in general and to surgeons in particular. The ideal procedure to stimulate the growth of a limb which is becoming shorter has not yet been found; consequently, operations such as multiple stapling to stop the growth of the normal and longer bones are being employed. The author submits a concept of the mechanism by which lengthening takes place in some pathological conditions and describes a method of altering some of the factors involved so as to cause overstimulation of growth in any long bone.

In studying the effect of penicillin in the treatment of acute hematogenous osteomyelitis in over 100 children, it was observed that a substantial number of them soon exhibited a disparity in the rate of growth in that the bone affected by the osteomyelitis was overgrowing the normal symmetric bone. Two factors were common in all cases showing important overgrowth: first, the lesion had been, from the beginning, mainly located in the diaphysis; second, the osteomyelitic lesion had always been very serious in nature and very extensive occupying sometimes the whole shaft. This type is characterized by a late sclerotic reaction in the diaphysis of the affected bone and hardly touches the metaphysis and not at all the epiphysis.

In the examination of bones in the process of overgrowth other factors were isolated. Only the bone affected by acute hematogenous osteomyelitis grew at an increased rate. In comparing it with the control unaffected limb of the same patient it was found that the increase in growth persisted for a year or a year and a half. In general, after this period of time the disparity in the rate of growth ceased, though the inequality tended to remain constant. Investigation as to whether any new factor had appeared to cause the accelerated growth to cease revealed one new finding. This was the opening of the bone marrow cavity, a process named by Louis Ollier in 1867 "medullization." When medullization began to appear the rate of overgrowth declined and when the bone marrow was totally reopened the rate of growth became equal to that of the normal leg.

From analysis of a large series of cases it seemed evident that a direct relationship existed between the overgrowth of the bone and the occlusion of the marrow. The hypothesis was advanced that the nutrient artery, which has been repeatedly shown to provide as much as 70 to 80 per cent of the total intraosseous blood, had been interrupted and the ischemia of the marrow was causing a hyperemia of the metaphysis. If the metaphyseal vessels which are potentially small nutrient arteries near the epiphyseal plate increase their blood flow, the consequence may be that the epiphyseal plate becomes better supplied with blood in its productive or metaphyseal side.

If this theory were true, overgrowth should not only occur in cases of obstruction of the bone marrow from an inflammatory process but also in fractures of the diaphysis of long bones with occlusion of the bone marrow space by callus. This is a very common finding in unreduced fractures of the femur in children with shortening initially and a spontaneous tendency to correction after consolidation of the callus. This tendency to natural improvement has been repeatedly attributed to a certain compensatory effort of nature of which we know nothing. In a series of cases published by Burdick and Siris all cases of fracture with overlengthening had the fracture localized at the diaphysis and in no case did fractures of the epiphysis or metaphysis show overgrowth.

The author then investigated in experimental animals the effects of prolonged interruption of the nutrient and periosteal circulation of the shaft of long bones and is convinced that the rate of growth is thereby increased. He is presently engaged in study of a procedure by which one could occlude in children the bone marrow space to accelerate growth.—*Arthur B. Smith, M.D.*

Sear, H. R. The congenital bone dystrophies and their co-relation. *J. Faculty of Radiologists*, April, 1953, *4*, 221–234.

Features of two or even more dystrophies may be associated in one case; that is, a similar fault in osteogenesis may produce two or more different types of dystrophy. Bones and their ossification may be considered from two aspects: (1) membranous bones and cartilaginous bones; and (2) endochondral and periosteal ossification. The author gives a table which is helpful in following his presentation.

Table I

THE CONGENITAL BONE DYSTROPHIES AND THEIR CO-RELATION

Bones			*Ossification*	
Membranous	*Cartilaginous*		*Periosteal*	*Congenital Condensing Osteodystrophies*
	(A) Growth	*(B) Mass formation*		
Craniostenosis associated with permanent parietal foramina	Achondroplasia Morquio's disease Connecting types	Diaphyseal aclasis Multiple enchondromata	Osteogenesis imperfecta	Osteopetrosis associated with Craniostenosis
Dysostosis cleidocranialis	Hurler's disease	Ollier's disease	Malacic type of Achondroplasia	with changes like Dystososis cleidocranialis
Acrocephalosyndactylism Apert	Malacic Type of Achondroplasia	Metaphyseal Dysostosis	Multiple Exostosis associated with Achondroplasia	
Facio-mandibular Dysostosis Berry Hurler's disease Achondroplasia Osteopetrosis	Achondroplasia associated with Multiple Exostosis			

In all the congenital bone dystrophies there are classical examples:

Craniostenosis—due to faulty osteogenesis of membranous bones

Achondroplasia—due to faulty endochondral ossification

Osteogenesis imperfecta—due to defective periosteal ossification, and to faulty formation and faulty calcification of trabeculae.

There are also many cases showing only minor changes, but enough to classify them with typical entities.

In craniostenosis it is generally accepted that the underlying fault is a premature synostosis between *membranous* bones, but in a typical case there is no premature closing of the sutures between the *cartilaginous* bones of the basal axis. In craniostenosis where there is a delay of the closing of a fontanelle an outward bulge at this fontanelle is seen. However, where so-called permanent parietal foramina are associated with craniostenosis an outward bulge does not occur at the so-called foramina, indicating that this radiolucent area is not an actual bone gap but is due to failure of bone to mineralize here and that it is occupied by dense fibrous tissue. Craniostenosis may be seen in association with changes in the phalanges similar to those in dysostosis cleidocranialis.

The membranous fault of craniostenosis may be seen in association with cartilaginous faults, such as Apert's acrocephalosyndactylism, which is craniostenosis accompanied by flipper-like hands and feet, due to lateral synostosis of digits, and of the bones of the digits. Also, in facio-mandibular dysostosis, in which there is a codfish-like deformity of the face with very poor development of the mandible, and with pre-auricular sinuses, deformed ears, big mouth and obliquely set eyes, probably due to a fault in development of the first visceral arch, the dystrophy may be associated with webbing of the fingers and with microdactyly.

In gargoylism (Hurler's disease) one may see craniostenosis sometimes with marked diploic channels in the frontal bone, associated with a flattened achondroplastic type of pelvis, shortening of the extremity bones with marked flaring-out and expansion of the ends of the diaphyses, and deformity of one or more vertebral bodies, particularly in the thoracolumbar junction area.

The association of the chondrodystrophies, achondroplasia and Morquio's disease or Brailsford's osteochondrodystrophy is discussed. The typical skull of achondroplasia (pug-face) is due to premature craniosynostosis of the *cartilaginous* bones at the base

of the skull. In achondroplasia one encounters disproportionate dwarfism, unusual muscular development with relatively large body and short extremities, straightness of the thoracic spine, flat wide chest with ribs flaring out horizontally, and lumbar lordosis (not present until after erect posture is assumed.) The pelvis is flat or kidney-shaped, the acetabula are well developed, and there is a relative lenghthening of the fibulae compared with the tibiae, giving a varus appearance. In unmixed achondroplasia the vertebrae are not deformed.

In Morquio's or Brailsford's disease the patients are weak muscularly, dwarfism is present but is more proportionate, the limbs are relatively longer, there is marked dorsal kyphosis, the chest is flattened from side to side, there is roof-tiling of the ribs, the vertebral bodies may be flattened or tongued, often flattened and narrowed anteriorly both from above and below. The pelvis tends to be narrowed transversely and lengthened sagittally and the acetabula are usually very wide, and shallow. Various changes may be seen in the femoral heads and necks from Perthes' disease to marked deformities such as non-development of the femoral heads and parts of the necks.

The features of achondroplasia and osteochondrodystrophy may be combined, with changes in the spine characteristic of osteochondrodystrophy but with changes elsewhere as in achondroplasia.

The three types of achondroplasia, the hypoplastic, the hyperplastic and the malacic are discussed. Sear believes that the malacic type depends on the association of the fault in osteogenesis, leading to achondroplasia, with the fault in osteogenesis that occurs in osteogenesis imperfecta, resulting in an alteration in the structure and architecture of the bones.

Hence, in the malacic type of achondroplasia, one sees the achondroplastic deformity associated with delicate, more slender bones, and with a somewhat looser, more definite trabeculation, a structural appearance like that of osteogenesis imperfecta. In addition to achondroplasia being associated with faulty periosteal ossification giving the malacic type, it may be associated with faults or gaps in the periosteum leading to the association of achondroplasia and diaphyseal aclasia in which multiple exostoses are seen.

Metaphyseal dysostosis is a congenital cartilaginous dystrophy affecting and confined to the ends of most of the diaphyses. Ollier's disease is a dystrophy closely allied to metaphyseal dysostosis with obvious shortening of the limbs and with cartilaginous defects in the ilia near the crests, in the pubes, and enchondromata in the shafts and diaphyseal ends of the long bones. Multiple enchondromata belong to the same group of dystrophies as Ollier's disease, but should not be classified as Ollier's disease unless associated with shortening of the limbs, whether unilateral or bilateral.

The author finally describes a patient showing changes in some of the vertebrae as in Morquio's disease, kidney-shaped pelvis as in achondroplasia, changes in the diaphyses resembling those of metaphyseal dysostosis, changes in the iliac crests similar to Ollier's disease, and a gap at the symphysis pubis similar to that seen in dysostosis cleidocranialis. He also emphasizes that there is an infinite number of variants from the typical pictures laid down in textbooks, minor cases and cases showing mixed abnormalities. The thought that there is such close association of changes depending on faulty osteogenesis in membranous bones and in cartilaginous bones, and in endochrondral and periosteal ossification, suggests that the faults in osteogenesis leading to these different dystrophies are very closely related.—*Samuel G. Henderson, M.D.*

Lichtenstein, Louis. Aneurysmal bone cyst; further observations. *Cancer*, Nov., 1953, *6*, 1228–1237.

Aneurysmal bone cyst is a distinctive lesion of bone commonly mistaken for the subperiosteal type of the giant cell tumor and occasionally for hemangioma and even osteogenic sarcoma.

The bone at the site of the aneurysmal bone cyst is completely transformed and ultimately resembles a peculiarly expanded blood-filled sponge, which, if untreated, may eventually reach an impressive size. The communicating pools of venous blood within this reservoir are bordered by connective tissue septa showing giant cell reaction, as well as more or less conspicuous reparative new bone formation, indicating attempted reconstruction.

The progress of the condition may be stopped by curettement and also by radiation therapy. The practical importance of its recognition lies in the fact that often it has been treated more aggressively than necessary.

This condition is most likely to be found in children, adolescents, or young adults of either sex. It may occur anywhere in the skeleton, but the long bones, the vertebral column and the flat bones are most frequently involved. The presenting complaint is generally pain, usually of several months' duration. At times limitation of motion or the presence of a mass may be elicited. Pressure on nerve roots, nerves or the spinal cord may occur.

The essential roentgen appearance is that of a more or less expanded area of bone with cystic changes. The area is often ballooned out to a striking degree. In the long limb bones the expanding lesion tends rather regularly to bulge eccentrically far beyond the neighboring intact cortical surface as giant cell tumor seldom does. The periphery of an expanded lesion is faintly outlined, as a rule, by a delicate shell of periosteal new bone. The rarefied lesion itself is often fuzzily mottled, sometimes traversed by fine septa and occasionally shows fine radiopaque areas indicative of focal calcification and/or ossification.

When occurring in a flat bone such as a rib, a clavicle or a scapula, the lesion usually expands symmetrically rather than protrudes eccentrically. In the vertebrae the lesion tends to balloon, although here the extent of expansion is usually less striking. The roentgen diagnosis is difficult in approximately one-third of the patients, particularly when the lesion is in a flat bone or when it has not attained a large size, since then it may be symmetrically expanded.

The pathological picture is that of a brownish, sponge-like, fibro-osseous meshwork, the ramifying spaces of which contain pools of blood. The pools of blood are bordered by vascularized fibrous connective tissue showing osseous metaplasia in places, and focal hemorrhage with conspicuous giant cell reaction. A lesion of aneurysmal bone cyst not far advanced in its development may show only partial cavernous transformation, although the still solid fibrous fields within it are also penetrated by numerous smaller vascular spaces.

The author's impression is that the lesion results from some persistent local alteration in hemodynamics (possibly venous thrombosis or arteriovenous aneurysm) leading to markedly increased venous pressure and the development of a dilated and engorged vascular bed within the affected bone area.

When the lesion is small, simple curettement is sufficient. Roentgen treatment may in small doses be curative. Large or excessive doses should not be given because of the demonstrated hazard of post-irradiation sarcoma. If the lesion is neglected and permitted to destroy neighboring bones and joints progressively and encroach upon important nerves and vessels in the adjacent soft tissues, eventually amputation becomes necessary.—*Frank J. Rigos, M.D.*

Holt, John F. Unusual "bone tumors" in infants and children. *Radiology*, Nov., 1953, *61*, 749–763.

The author presents a wide variety of unusual bone lesions in infants and children which are illustrated with roentgenograms. The films are viewed with the following questions in mind:

1. Is the bone significantly abnormal?
2. If abnormal, is the lesion neoplastic or non-neoplastic?
3. If neoplastic, is the lesion benign or malignant?
4. If malignant, is the lesion primary or metastatic?
5. If neoplastic, can the tumor type be identified?

1. Is the bone significantly abnormal? Two anatomic variants are considered. The double contour effect, confined almost exclusively to infants, must be differentiated from neoplastic periosteal involvement in which there is usually a thin lamination associated with underlying bone destruction. Isolated *cortical defects* are common in healthy asymptomatic children, being most common in the medial metaphysis of the femur. They are unilocular or multilocular cyst-like shadows which occur during the transformation of cartilage into bone.

2. If abnormal, is the lesion neoplastic or non-neoplastic? The differential diagnosis between Ewing's tumor and osteomytlitis is difficult. Traumatic periostitis is common in children and unless associated with a fracture, malignancy should be excluded. A suspected tumor of the shoulder in a child was diagnosed as scurvy with the aid of a skeletal survey in which other extremities were seen to be involved. Another shoulder lesion of infantile cortical hyperostosis with eventual involvement of the mandible is presented.

3. If neoplastic, is the lesion benign or malignant? The difficulties of differentiation are discussed. A case of monostotic eosinophilic granuloma of the femur and one of a benign bone cyst of the humerus mistaken by the roentgenologist as malignant tumors are presented. A similar appearing lesion from Hodgkin's disease is included for comparison.

4. If malignant, is the lesion primary or metastatic? A chondrosarcoma of the shoulder which metastasized to other bones is presented as a rare occurrence. The unusual lesions of hemangioglastoma in an infant are presented.

5. If neoplastic, can the tumor type be identified? Many of the time-honored roentgenologic signs considered at one time to be pathognomonic have through the years proved to be of limited diagnostic value. A case of hemangioma mistaken for osteoid osteoma and one of primitive hemocytopblastoma mistaken for osteogenic sarcoma are presented.

The merits of biopsy are discussed and emphasized. The author states that, in general, surgery still reigns supreme in the field of treatment of these bone lesions, but that irradiation, chemotherapy, and hormones all have an important part in their management.—*Everett E. Seedorf, M.D.*

Blood and Lymph System

Cooper, Donald R., Brown, Robert C., Stone, Charles H., III, and Ferguson, L. Kraeer. Splenoportography. *Ann. Surg.*, Oct., 1953, *138*, 582–592.

The authors employed this diagnostic procedure in 12 patients. Three were injected to test for patency of a portocaval anastomosis. Six patients had Laennec's cirrhosis, and 2 of the 6 had esophageal varices. One patient had hepatocellular jaundice and 2 patients had pancreatic carcinoma.

The term "splenoportography" and the technique used were borrowed from the work of Sotgiu, Cacciari and Frassineti. Under local anesthesia with 1 per cent procaine and, with the patient lying supine on the roentgenographic table, a palpable spleen is usually penetrated through the left 10th intercostal space in the mid-axillary line. For small spleens the 9th intercostal space is selected and the puncture made as far posteriorly as the supine position will

allow. A No. 17 3 inch needle is used, and when the needle strikes the peritoneum the patient will usually experience some discomfort. The needle is advanced cautiously until the operator feels the scrubbing sensation of the spleen passing back and forth over the tip of the needle with each respiration. The patient is then asked to inspire and hold his breath. The needle is thrust 2 cm. into the spleen and 20 ml. of 75 per cent diodrast or urokon is injected in four seconds. During the fourth second, the first roentgen exposure is made. The needle is then withdrawn and 5 postinjection exposures are made as fast as the cassettes can be changed, usually at four to five second intervals.

Splenoportography has proved valuable in determining patency of a portocaval anastomosis. Intrahepatic and extrahepatic portal blocks may be differentiated preoperatively, as the filling of tributaries to the splenoportal venous system and the delayed emptying of these tributaries of the main venous channels are indications of intrahepatic portal block. The authors state that a study of normal control patients is essential before these facts can be established.

Advanced lesions of the pancreas and other retroperitoneal neoplasms can be identified if they impinge on splenic or portal venous flow. Invasion of the portal vein by carcinoma of the head of the pancreas can probably be diagnosed preoperatively. It has not yet been determined whether this examination will be of great value in the early diagnosis of pancreatic neoplasms.

The majority of patients experienced some discomfort immediately after the injection, which was well controlled with appropriate doses of demerol. One patient with cirrhosis and ascites developed left upper quadrant pain and went into shock a few hours after injection. He was treated with 1,000 cc. of blood by transfusion and had no further difficulty. Four patients underwent laparotomy soon after splenoportography, and in no instance was more than 50 cc. of blood found in the peritoneal cavity. Two of the spleens were examined carefully and no abnormalities were noted at operation. If uncontrollable hemorrhage from the spleen should arise, splenectomy would have to be performed and for this reason the authors hesitate to do splenic injection on any patient who could not safely undergo splenectomy.

Discussion of this paper by Drs. Blalock, Rousselot, Child, and Poth indicated that all considered the procedure of value but felt that additional visualization of the portal vein at operation by direct injection of the superior mesenteric vein or a branch of this vein was indicated for adequate study.—*A. B. Smith, M.D.*

Wyburn-Mason, R. Costo-clavicular compression of the subclavian vein. *Brit. M. J.*, Nov. 28, 1953, *2*, 1198–1200.

One of the causes of edema of the upper extremity was found to be compression of the subclavian vein secondary to trauma to the structures of the shoulder girdle. Two cases are presented.

In 4 of 32 cases investigated by the author, elephantiasis of the arm following radical mastectomy (but prior to radiation therapy) was associated with obvious drop of the shoulder girdle of the involved side. Moreover, swelling subsided when a sling was placed to elevate the elbow and thus the shoulder girdle of these 4 as well as the 2 cases resulting from trauma.

A report of the findings in 1 case is given. Venous pressure was elevated to 105 mm. in the affected extremity. A phlebogram showed holdup of the radiopaque material at the outer edge of the first rib on this side, but not on the other. Relief of edema was afforded by elevation of the shoulder with a sling. —*Thomas B. Efford, M.D.*

Stiff, Donald W. S., and Powell, George M. Roentgenologic observations in hemorrhagic fever. *Radiology*, Nov., 1953, *61*, 807–813.

The roentgenographic findings in patients with hemorrhagic fever are presented. One hundred and eighty-one patients with this disease were studied roentgenographically, and associated abnormal findings found in 26. The clinical course and the general pathological processes are also briefly discussed. A case report is included.

In 2 cases, generalized gaseous distention of the small and large intestine was demonstrated, but otherwise, abnormal roentgenographic findings were limited to the chest. Here, evidence of both focal and central pulmonary congestion was observed—with the latter characterized by widening of the hilar pulmonary vascular markings, with increased linear densities extending out into the lung fields and some dilatation of the pulmonary vessels. The numerous patchy congested areas may coalesce, and either or both types of congestion together can be seen. The changes in the central type, noted on serial films, correlated well with kidney function, and it is thought that these congestive changes probably are associated with the lower nephron type of renal failure that occurs. Peribronchial infiltration and occasionally localized consolidated areas of pneumonia also appear.

In those patients that recovered, complete clearing of the chest occurred within two to eight days, while in the fatal cases almost complete obliteration of lung markings by clouding from extreme pulmonary edema was seen terminally.

This roentgenographic picture is not diagnostic; the observations only illustrate the changes seen in the chest during the course of hemorrhagic fever.—*Charles L. Stevenson, M.D.*

Custer, R. Philip. Borderlands dim in malignant disease of the blood-forming organs. *Radiology*, Nov., 1953, *61*, 764–770.

There is a definite interrelationship between the various forms of malignant disease of the blood-forming organs. All these neoplastic processes have as their common bond the origin of their cellular components in the reticuloendothelial system. Cells of the reticuloendothelial system may be regarded as counterparts of embryonal mesenchyme, and, as such, retain multipotential qualities throughout life. They remain the stem cells of the bloodforming, lymphatic and connective tissues.

Lymphomas are classified, according to their predominating histopathological pattern, as follows: (1) the follicular type, characterized by nodules resembling lymphoid follicles, (2) the lymphocytic type, with uniform mostly round cells, (3) the reticulum-cell type, with cellular pleomorphism, (4) the Hodgkin's lymphoma, which includes the paragranuloma and sarcoma. The two forms of leukemia most closely associated with these are the lymphocytic and the monocytic types.

Transition from one form of lymphoma to another is a common occurrence. Transitions actually observed are shown in several excellent diagrams. For example, follicular lymphoma rarely remains as such throughout its entire course. Most frequently the transformation is toward reticulum-cell or Hodgkin's sarcoma, with lymphosarcoma of a well differentiated type next in order. A change to Hodgkin's paragranuloma is not uncommon, with further progression through the granuloma to the sarcoma in some instances. A transition to lymphocytic leukemia occurs at times, but a change to monocytic leukemia is rare.

The Hodgkin's group exhibits a marked instability. In many instances a mixed histopathologic pattern will be found, sharing paragranulomatous, granulomatous and/or sarcomatous features. A two-directional bond exists between lymphosarcoma and reticulum-cell or Hodgkin's sarcoma. A similar relationship exists between monocytic leukemia and reticulum-cell sarcoma, and between lymphocytic leukemia and lymphosarcoma.

It is emphasized that one patient may have, simultaneously or in series, two or more varying lymphomatous lesions which are of the same origin and part of one disease.—*Arno W. Sommer, M.D.*

Petković, S. Darstellung der Beckenvenen durch verschiedene Wege. (Demonstration of the pelvic veins by various methods.) *Fortschr. a. d. Geb. d. Röntgenstrahlen ver. m. Röntgenpraxis*, Dec., 1953, *79*, 739–745.

The contrast substance used was a 70 per cent solution of ioduron.

The injection can be carried out into the following structures:

1. The femoral vein. An obstruction of the common iliac or external iliac veins can thus be visualized.
2. The os pubis. The injection must be made simultaneously on both sides. The retropubic veins and obturator veins are visualized by this method.
3. The ischiatic tuberosities bilaterally. The pudendal veins, the obturator veins and anastomoses with the iliac veins are demonstrated.
4. The iliac crest. The external iliac, the obturator, internal pudendal, internal iliac and common iliac veins on one side are filled.
5. The greater trochanter, with filling of the surrounding veins and the internal iliac veins.
6. The deep dorsal vein of the penis. Injection fills the retropubic plexus, the internal iliac and common iliac veins.
7. The cavernous plexus of the penis. This method is followed by painful erections and priapism.
8. Clitoris, with filling of the veins of the clitoris and bulbus, as well as of the perineal, pudendal, hypogastric, common iliac and presacral veins and the pudendal plexus.
9. The uterine cervix. This method is successful where the cervix is vascular and soft; usually the uterine plexus and uterine veins, the internal iliac and common iliac veins are filled. Thus, this method visualizes the visceral pelvic veins, while the other methods render mainly the parietal veins visible.

The author carried out pelvic venography in 75 cases, without serious complications. Vomiting and hot flashes were encountered occasionally. He prefers injection into the clitoris and the cervix and, in men, into the ischiatic tuberosities. The method was found valuable in deep thrombosis of the pelvic veins. The typical roentgen findings consisted in demonstration of collaterals and narrowing of the lumen with irregular contours. This is thought to be due to recanalization of old thrombi. In pelvic tumors, displacement, compression of veins and collateral circulation were demonstrated. In some cases of cancer of the uterine cervix, Stage III, treated by radiation therapy, narrowing of the parametrial veins was found, varicosities of the peloic veins were noted in women who had varices of the lower extremities. —*Karol E. Matzinger, M.D.*

Rabaiotti, Antonio. Semeiologia venosa nella trombosi dell'arto inferiore e del bacino mediante applicazione di varie metodologie flebografiche. (Venous changes in thrombosis of the lower extremity and pelvis with application of various methods of phlebography.) *Ann. radiol. diag.*, 1953, *26*, 340–368.

The article begins with a discussion of thrombophlebitis and phlebothrombosis with a review of the literature on this subject. Next it deals with the various methods for visualizing the veins of the lower extremity. The author emphasizes that thorough knowledge in venous pathology and an extensive experience in phlebography are most important in this work.

Usually the author injects the largest vein on the

dorsum of the foot with a constricting band just above the ankle to visualize the deep veins of the foreleg and thigh. This method is not too useful for filling the veins in the upper thigh and pelvis. According to the case under consideration one may resort to either injection of a large superficial vein in the thigh or a retrograde filling by injection of the femoral vein. When the dorsum of the foot is unsuitable for injection purposes the intraosseous injection of the calcaneal bone is used. Thus one should be familiar with all methods and use the one which is most appropriate for the case under consideration.

The article has many good illustrations and is an excellent review of the subject. It certainly impresses one how complicated phlebography of the lower extremity can be in order to demonstrate the underlying pathology by this method. Close cooperation with the vascular surgeon is necessary to obtain a high percentage of profitable returns in correct diagnosis.—*Peter E. Russo, M.D.*

Boyd, A. M., Catchpole, B. N., Jepson, R. P., and Rose, S. S. The technic and interpretation of lower limb phlebography. *Ann. Surg.*, Nov., 1953, *138*, 726–733.

This study is based on 250 cases examined at the Manchester Royal Infirmary Surgical Department with phlebograms and venous pressure determinations both at rest and during exercise.

The authors use 50 per cent diodone (diodrast), or a 70 per cent solution in heavy patients. There have been some minor reactions and in several cases a thrombophlebitis involving a short length of subcutaneous vein at the site of injection was observed. When patients with a recent history of thrombophlebitis require investigation they use thorotrast.

A small dorsal vein on the foot is exposed, cannulated with a polythene tube of 1 mm. internal diameter and connected to a bottle of normal saline. Estimates of venous pressure are made. Diodone is then injected and one film is exposed with the patient in the lateral position to include the leg and lower half of the thigh; this exposure is made at the end of the rapid injection of 20 cc. of contrast medium. The second film is taken in the anteroposterior position of the thigh sixty seconds after injection of the contrast medium to demonstrate the femoral vein. With the Valsalva maneuver and competent valves the femoral vein is well outlined; with incompetent valves the diodone may be forced distal to the film. If the contrast medium pools in superficial varicosities they should be massaged upwards before a repeat exposure. Percutaneous injection is more difficult but successful if a large needle is used. The posterior tibial vein is not satisfactory for injection.

The authors stress the point that in phlebography the contrast medium may remain on one side of the vessel due to "streamlining" and not to thrombus. If a vein does not fill it may be in spasm, blocked by thrombus or normal although poorly filled. Spasm often follows recent acute thrombophlebitis. Thrombosis must be diagnosed cautiously and filling of collateral veins bypassing the area is of importance. Dilution of the contrast medium is sometimes seen proximal to an arteriovenous fistula or at the ends of the column of medium. Recanalization of occluded veins can be demonstrated lying within the wall of the original vessel; such veins appear tortuous, valveless and narrow.

Phlebograms show the extent of old phlebitic processes, the site of obstruction, the degree of valvular competence and the condition of the veins. They are useful in the investigation of swollen legs or ulcerated legs, where the diagnosis is in doubt, when the study is correlated with the functional capacity.—*Martha Mottram, M.D.*

General

Umiker, William, and Jaffe, Henry L. Ossifying fibrosarcoma (extraskeletal osteogenic sarcoma) of thigh muscle; report of a case with recurrence and widespread metastases more than four and a half years after excision. *Ann. Surg.*, Nov., 1953, *138*, 795–800.

The authors' case was a thirty-nine year old white man in whom a tumor was incidentally found in the upper posterior portion of the right thigh. This tumor was removed in July, 1947, and was regarded as a low grade fibrosarcoma. Bony trabeculae were found in the tumor. The patient was well until 1951 at which time a chest roentgenogram showed two masses in the left lung. These were not thought to be related to the original tumor. However, following removal of the lesions, microscopic sections showed cellular areas of the spindle cells which alternated with large foci of chondroblastic and osteoblastic cells of a bizarre type.

Several months later, a small mass was found at the site of the original tumor. This was removed and microscopic sections showed a similar histopathology to that of the pulmonary metastases. The patient's condition began to deteriorate and he died in April, 1952. Autopsy revealed generalized metastases involving the lungs, liver, mesentery, chest wall, ribs, peritoneum, scalp and the epidural spaces. Microscopic sections showed large spindle cells with moderate pleomorphism and considerable mitotic activity. There were many areas of osteoid formation, but with few osteoblasts. Some bone was being formed. The metastases were not unlike those seen in osteogenic sarcoma.

H. Wilson reviewed the literature in 1941 and found 30 cases of malignant extraskeletal bone forming tumors. Included in the cases were several originating in skeletal muscle. Bone formation in neoplasms is usually regarded as a degenerative process within the tumor. Occasionally, osteogenic activity plays an active role in the tumorous process. Osteo-

mas or osteochondromas of the dura, tongue and retroperitoneal spaces have been reported. Broders believes that extra-osseous osteogenic sarcomas arise as a result of anaplasia of fibrous tissue cells to fibrosarcomas and that these cells then differentiate into osteoblasts. Stout emphasizes the multipotential differentiating ability of mesenchymal cells and reports tumors showing combinations of fibrosarcoma, liposarcoma, rhabdomyosarcoma, and osteogenic sarcoma mesenchymal).

The authors conclude that: (1) a more guarded prognosis should be made in connection with soft tissue tumors of this type, and (2) the histopathological findings in this case support the theory that mesenchymal cells which can differentiate into neoplastic fibroblasts can also differentiate into neoplastic chondroblasts and osteoblasts.—*Charles W. Cooley, M.D.*

RADIATION THERAPY

Spina, Victor, Raia, Rui, and Reginato, Luiz Eugênio. Tratamento do quelóide. (Treatment of keloids.) *O Hospital*, Oct., 1953, *44*, 497–515.

The authors discuss the classification, etiology, pathology, clinical aspect and treatment of keloids. Their own experience is based on 15 cases treated by a combination of surgery and roentgen therapy at the University Hospital of São Paulo, Brazil. Ten of the cases are presented in detail and profusely illustrated with photographs taken before and at various intervals after treatment. The period of follow-up observation extended from six months to six years.

Good results were obtained in the majority of the cases. The following is a more detailed account of the procedure used: (1) resection of the keloid and suturing of the skin with atraumatic nylon thread "0000" in separate stiches; (2) fractionated roentgen therapy, beginning twenty-four hours after the operation and continuing in series of four biweekly treatments, with intervals of two months between the series, until a total dose of 1,400 to 1,750 r has been given; (3) multiple-stage rather than single-stage resection of large keloids whenever possible so as to avoid skin grafting and thus permit postoperative irradiation; (4) use of zig-zag incision whenever the keloid does not coincide with the lines of force; (5) avoidance of skin flaps for the covering of raw areas of the face following removal of large keloids since the new cicatrization may also lead to keloid formation; and (6) application of strips of sticking plaster over each operated area which is continued for five to six months.—*T. Leucutia, M.D.*

Wynne, E. Staten, Hinds, David B., Gott, Cora L., Russell, W. O., and Fletcher, G. H. Response of irradiated cancer patients to Vibrio metschnikovii. *Science*, Oct. 16, 1953, *118*, 442–443.

Marked depression of production of H agglutinins in patients receiving heavy irradiation has been reported (Evans, R. W., *J. Path. & Bacteriol.*, 1948, *60*, 123), as tested by a single injection of *S. paratyphi*.

Fifty-three individuals were injected with three weekly subcutaneous doses of a vaccine prepared from *V. metschnikovii* (a fowl pathogen not reported in man). Eleven of these subjects were apparently healthy. The remaining 42 had various malignant neoplasms and 29 of these were receiving roentgen or radium therapy during the course of the experiment. Titers were determined by a growth agglutination technique upon blood samples drawn during and after the course of vaccine injections. Native antibodies were unexpectedly encountered in over half the group and these titers were recorded as increases.

There were antibody responses in both irradiated and nonirradiated subjects of a statistical homogeneous nature, conflicting with the findings of Evans. No significance could be attached to the integral dose, time of irradiation, site of irradiation, or type of malignancy. It is noted that the sensitivity of the present test system is less than that utilizing *S. paratyphi*. It cannot be concluded that irradiation has no effect upon immune defenses.—*J. Maurice Swain, M.D.*

Beierwaltes, William H. X-ray treatment of malignant exophthalmos: a report on 28 patients. *J. Clin. Endocrinol. & Metabol.*, Sept., 1953, *13*, 1090–1100.

It is assumed that malignant exophthalmos is caused by increased action of the thyroid stimulating hormone of the pituitary on the periorbital tissues. Roentgen therapy to the pituitary is therefore a rational method of treatment.

Twenty-eight cases are reported in which such treatment was given. All of them had two or more signs of malignant exophthalmos, such as lid edema, bulbar conjunctival edema, limitation of extraocular muscle movement of the eyes, inability to close the eyes, and corneal ulceration. Usually ten evenly spaced exophthalmometric measurements were made on each patient during the period of study which ranged from six to eighty-seven months with an average of twenty-eight and two-thirds months. Adjunctive local therapy included vaseline or boric acid ointment at night, 0.25 per cent methylcellulose eye drops during the day, and tarsorrhaphy. A representative course of roentgen therapy consisted of 150 r in air delivered to each temporal area daily to a total of 1,500 r per field of 8 by 7 cm., with 200 kv., 0.5 mm. Cu plus 1 mm. Al filtration, at a skin target distance of 50 cm.

Thirteen of the 28 patients showed a significantly favorable response. Improvement began as early as three months and as late as twenty-four months after irradiation with maximum recession at an average period of eleven and two-thirds months. In

general, the associated signs and symptoms improved as the exophthalmos receded but patients showing the greatest response by exophthalmometric measurement did not necessarily show the greatest improvement in the other eye signs. Study of the successful and unsuccessful cases indicated that duration before therapy was an important factor in the outcome. The condition usually responded to irradiation if it had been present less than one year and rarely responded if it had been present more than two years. Such a variation in the response can well be explained on the basis of the pathological findings, since the condition begins as an orbital infiltration simulating a chronic inflammatory reaction and progresses to a chronic fibrosis. These pathological findings also afford a rationale for direct treatment to the orbital region as has been advocated by others.

It was noted that patients with coexistent thyrotoxicosis were more resistant to treatment. Administration of desiccated thyroid failed to influence the response in these cases.—*Leslie K. Sycamore, M.D.*

Adams, Herbert D., Hare, Hugh F., Davis, Wirt L., Trump, John G., and Granke, Richard C. The treatment of carcinoma of the esophagus and cardia by resection and postoperative supervoltage roentgen rays. *Ann. Surg.*, Oct., 1953, *138*, 631–642.

Present results of the treatment of carcinoma of the esophagus are poor in terms of five year survival in spite of modern radical surgical techniques, antibiotics, new supportive measures and new diagnostic tools. To evaluate their modern results, the authors reviewed the 161 cases of carcinoma of the esophagus seen at the Lahey Clinic from 1945 through 1949. Of this number 42.9 per cent had resectable lesions and in the resected cases there was a 4.5 per cent five year survival.

In an attempt to improve results, the authors recommend supervoltage radiation therapy to destroy residual carcinoma in the esophageal bed. As proof that such carcinoma can be destroyed by irradiation, they present 2 cases. One case was inoperable and had distant metastases but was given therapy using rotational technique with the 2 million volt unit at the Massachusetts Institute of Technology. In thirty-five treatment days 6,000 r was delivered to the esophagus. At autopsy two months later numerous metastases were found but there was no evidence of carcinoma remaining in the esophagus, the mucosa being absent at the site of the tumor. The pericardium was undamaged and there were a few areas of fibrosis in the lungs.

In another case a carcinoma of the cardia of the stomach was found to be invading the tail of the pancreas and had metastasized locally so widely that the lesion was not resectable. The patient was given roentgen therapy with the 2 million volt unit at the rate of 170 r per day through anterior and posterior ports for thirty treatments for a total of 5,000 r to the stomach and surrounding structures. At autopsy one year later the lymphoid tissue in the field was almost obliterated and there was no evidence of tumor cells in the remaining lymph nodes. An ulcerative lesion in the cardia had a small area of carcinoma remaining deep in its base. There were multiple distant metastases.

The authors believe that esophageal carcinoma should be resected whenever possible before irradiation. This restores continuity of the gastrointestinal tract leading to improved nutrition and avoids complications such as perforation and hemorrhage due to sloughing of the tumor. If resection is not possible, gastrostomy should be performed.

The roentgen dose suggested is 6,000 r to the tumor.—*Henry J. Klos, M.D.*

Smith, George V., and Smith, Olive W. Carcinoma of the breast; results, evaluation of x-radiation, and relation of age and surgical castration to length of survival. *Surg., Gynec. & Obst.*, Oct., 1953, *97*, 508–516.

This report is based on a study of the records of 739 ward and private patients with previously untreated mammary cancer, who came under the care of the staff of one hospital from 1905 to 1946. The cases are consecutive and unselected. The diagnosis in every instance was made or confirmed by microscopic examination, as was the presence or absence of metastasis in the axillary lymph nodes, with the exception of those not operated upon. The tumors were graded 1, 2, or 3 according to increasing histopathologic degree of malignancy.

An endocrinologic aspect of the disease is introduced by the finding that a poorer prognosis is associated with the climacteric. The evidence supports the idea that longer survival may be achieved by prophylactic surgical castration. It also supplements the evidence of those who have found that irradiation as a part of the primary treatment lengthens survival.

A study of patients with Grade 2 and 3 tumors was made, in relation to roentgen therapy. Only those who were operated upon since September 1, 1917, when roentgen therapy was started, are included. The authors believe that primary irradiation is effective only in patients with cancers of high histopathologic malignancy, whether or not the axillary lymph nodes are involved.

The study points to the fact that primary irradiation had not been of any advantage in patients with negative lumph nodes. They believe that since the histopathologic differentiation between Grade 2 and 3 tumors is not sharp, it is probably wiser to administer irradiation to all patients with axillary metastases. They suggest that patients with high grade tumors having negative axillary lymph nodes should be treated by roentgen therapy for possible

metastases in the supraclavicular and internal mammary lymph nodes as well as residual tumor in the area of operation.

A study of the relation between age at operation and length of survival was made. Since such relationship might be associated with changes in ovarian function, all cases of surgical or radiation castration performed before there was any indication of recurrent cancer were omitted. There were 101 such patients omitted. The remainder were studied in age groups 35 to 39 years, 40 to 44, and so on through 64, and finally those over 65. It was found that the lowest survival rates were in the climacteric age groups, that is, 40 to 60 year, at the time of operation. No differences in the distribution of these cases among variables other than age could be found.

In a study of the relation between prophylactic surgical castration and length of survival, it was found that for all groups (radical mastectomy with positive lymph nodes, radical mastectomy with negative lymph nodes and all cases both radical and simple mastectomy) the higher rates of survival were among the castrates. There were no irregularities in the distribution of patients as regards age, duration of symptoms, roentgen therapy and grade of malignancy which might have accounted for these findings.

In a study of the relation between prophylactic irradiation of the ovaries and length of survival, it was found (in 41 patients) that the 40 per cent of five year salvage was considerably inferior to the 74 per cent in the surgical castrates.

They conclude that (1) primary roentgen treatment in conjunction with surgery had prolonged life among patients with axillary metastases; (2) the lowest percentage of survivors was among women between the age of 40 and 60 years, that is, during the premenopausal and postmenopausal climacteric; (3) prophylactic ovariectomy had prolonged life not only in women under 40 and over 59 years but more so in those 40 to 59 years old; and (4) there was some evidence of lengthened survival from prophylactic irradiation of the ovaries.—*Robert K. Arbuckle, M.D.*

Morgan, Russell H. Protection from roentgen rays. *Am. J. M. Sc.*, Nov., 1953, *226*, 578–586.

The author gives an excellent review of the protection from roentgen rays. The application of roentgen radiation has become so extensive that many health physicists have become concerned lest the benefits of roentgen diagnostic procedures be largely counterbalanced by the hazards which they carry With this in view, the author has studied the dangers of exposure to roentgen radiation and he indicates the measures by which these dangers may be minimized. He states that such a review at this time is particularly desirable because of the increasing number of physicians, using roentgen apparatus in their daily practice, who have not had specialized training in the field of radiology.

He reminds us of the damage the pioneers in radiology received or suffered to their hands and body because they did not anticipate the dangers of excessive radiation exposure and took few precautions to protect either themselves or their patients The damage suffered by the early radiologists did not manifest itself immediately, but instead became apparent only after a period of several years As a result, it was many years after the discovery of the roentgen rays, that the radiation-induced changes of the hands of radiologists increased, and it was at this time that the dangers of excessive radiation exposure were recognized and efforts to provide adequate protection from them were undertaken.

The author distinguishes four anatomical systems likely to suffer most seriously from excessive radiation exposure in diagnostic radiology: (a) the cutaneous tissues; (b) the hemopoietic system; (c) the reproductive system; and (d) the osseous system (in children). Taking each of these systems separately he reviews the hazards encountered, the maximum exposures to patient and radiologists, and the protection or change in technique that would reduce or eliminate the radiation hazards.

Throughout the discussion most of the emphasis is placed on the hazards of fluoroscopy. This is done because there has been a practice among some physicians, who have not been trained in radiology, to increase the milliamperage of their fluoroscopic equipment to values considerably in excess of 5 ma. for the purpose of augmenting the brightness of the fluoroscopic screen and thus reducing the need for lengthy periods of dark adaptation. Since the radiation dosage to the patient varies proportionately to the milliamperage, this practice is highly condemned as well as lengthy exposure times during fluoroscopic examination. The author recommends that the fluoroscopic equipment should include an interval timer which will limit the exposure to any given patient to a value of five minutes or less.

Convenient data, which require no tedious mathematical calculations, are now available by which barrier requirements for a wide range of diagnostic installations may be easily determined. If these data are followed in the design of roentgen installations and if the easily applied fluoroscopic recommendations made throughout this review are employed, the problems of radiation protection in diagnostic radiology will be greatly minimized.—*T. E. Padgett, M.D.*

Schulz, Milford D., and Stetson, Charles G. Radiation therapy of malignant lesions about the eye. *Radiology*, Nov., 1953, *61*, 786–795.

Tumors arising in the tissues about the eye are arbitrarily classified and discussed as follows:

I. Orbital tumors

Angiomas account for about 15 per cent of all orbital tumors. They should be treated like angiomas elsewhere in the body. The "port-wine" and cavernous types respond poorly.

Lymphomatous disease makes up about 10 per cent of all neoplasms about the eye. The primary conjunctival lymphomas often respond to roentgen therapy and remain cured. When associated with generalized disease the outlook is grave. Treatment is the same as for lymphoma elsewhere. *Mickulicz's disease* is a lymphomatous disease which may respond to 600 to 800 r roentgen therapy.

Dermoid tumors do not respond to radiation therapy.

The so-called "mixed" tumors of the lacrimal gland do not respond to radiation therapy, but the adenocarcinoma is quite radiosensitive.

Sarcoma is usually radioresistant.

Granulomas, "pseudo-tumors," are self-limited requiring no treatment. However, eosinophilic granuloma and Hand-Schüller-Christian's disease are quite radiosensitive.

II. Extra-orbital tumors

Carcinomas of the nasal sinuses extending to the orbit are largely problems of palliation by radiation therapy. Meningiomas are best handled by the neurosurgeon.

Retinoblastoma is the principal tumor of the *uveal tract* which concerns the radiologist. It is radiosensitive and curable. *Malignant melanomas* are radioresistant and strictlly surgical problems.

III. Adnexal tumors

Carcinoma of the conjunctiva is amenable to either surgery or radiation therapy, but is usually best handled surgically.

Carcinoma of the eyelid is the most common of the tumors about the eye. Basal cell carcinomas comprise about 85 per cent of the lesions. The lower lid is most frequently involved and the inner carthus next most frequently.

When irradiating a carcinoma of the eyelid, the eye beneath must be protected from incident radiation with a shield. For purposes of treatment, carcinoma of the eyelid may be divided into four categories:

Class I. Small, non-infiltrative lesions which usually involve the palpebral margins. Good cosmetic results are obtained by protracting roentgen therapy over a week's time with a total dose of 4,500 r.

Class II comprises tumors which infiltrate the lid and destroy tissue. They can be cured by radiation therapy, but may result in cosmetic defect. Therefore, it may be better to have immediate excision of the tumor and surgical restoration. If radiation therapy is used, fractionation is very desirable for better cosmetic results.

Class III is made up of the long neglected or mistreated tumors which invade the orbit, etc. Roentgen therapy should be attempted first and, if unsuccessful, surgical evisceration becomes necessary.

Class IV contains incurable tumors such as those with metastases. Therapy is palliative and can often be accomplished best by irradiation.

The total ultimate success of roentgen therapy in early cancer of the eyelid is around 90 per cent. The likelihood of failure in squamous cell carcinoma is far greater than in basal cell carcinoma.

Complications include stenosis of the tear duct, tearing, deformity of the lids, conjunctivitis or keratitis, cataract and loss of the eye. These are discussed in detail and methods of avoiding them are described. —*Everett E. Seedorf, M.D.*

Wildermuth, Orliss, and Cantril, Simeon T. Radiation necrosis of the mandible. *Radiology*, Nov., 1953, *61*, 771–785.

Dental caries and necrosis of the mandible are troublesome and sometimes disastrous complications following intensive irradiation of tumors of the oral cavity. Osteonecrosis is usually the result of the triad of heavy irradiation, trauma and infection. Whenever the vascularity of the mandible has been impaired by irradiation, there is little response to bacterial invasion, and necrosis may progress to involve the entire irradiated bony part.

The authors have undertaken a study to determine the value of pre-irradiation extraction of teeth as a method of preventing postirradiation caries and pain and the more serious complication of necrosis of the mandible. Two hundred and sixty-two patients were seen with intraoral cancer between 1939 and 1951. One hundred and four patients were considered acceptable for this study. Thirty-two patients (31 per cent) with teeth presented themselves for treatment. Seven were treated without preliminary extractions. Five of these patients developed caries, making extraction necessary because of severe pain. In none did this proceed to osteonecrosis of the mandible even when the teeth were removed years after irradiation. Prophylactic extractions were performed in 25 patients. The mucosa healed in seven to sixteen days and therapy was begun. Fourteen patients received roentgen therapy. Six of these were free of mandibular complications, and 2 died without primary healing of their lesions and with progressive mandibular necrosis and tumor. In 6 there was complete healing after treatment, with subsequent development of caries and necrosis of the mandible. Seven patients were treated with radium and 4 patients with cancer of the tongue were treated with combined roentgen and radium therapy. None of these developed mandibular necrosis.

Seventy-two patients (69 per cent) were completely edentulous, with well healed gums and had no extractions less than three months previous to treatment. Mucosal necrosis developed in 9 patients but in no instance was there progression to osteo-

necrosis of the irradiated mandible. There was sloughing of the maxilla in 1 case subsequent to trauma to the irradiated area.

It is concluded that, with modern antibiotics and meticulous care, the teeth can safely be extracted when and if they become painful and carious after treatment. Irradiation before reconstruction of the alveolar ridge of the mandible after prophylactic extraction of the teeth in the field of irradiation results in permanently delayed remodeling of the mandible and a persistent threat to the integrity of the overlying gingival mucosa. Reconstruction of the mandible occurs normally in those in whom the teeth are removed even several months to years after completion of radiation therapy.—*Arno W. Sommer, M.D.*

Walker, John H., and Jones, Hugh W. The irradiation management of primary round-cell tumors of bone. *Radiology*, Nov., 1953, *61*, 738–748.

Accurate classification of Ewing's sarcoma, reticulum-cell sarcoma, and solitary myeloma may at times be impossible. This problem is being recognized with increasing frequency by those reviewing large series of bone tumors. Numerous errors in diagnosis have been found by the authors and by other investigators. When round-cell tumors have been critically re-evaluated, Ewing's sarcoma has frequently been shown to be an erroneous diagnosis. The final diagnosis was reticulum-cell sarcoma in a substantial percentage of the cases studied.

Solitary myeloma and primary reticulum-cell sarcoma have a relatively good prognosis when adequately treated. Curative, rather than palliative treatment should be undertaken. The results of those reporting on series of reticulum-cell sarcoma sufficiently large to be statistically significant indicate that the treatment of choice is irradiation. Amputation, either alone or in conjunction with irradiation, does not offer a greater chance of survival.

The authors report 3 cases of reticulum-cell sarcoma originally diagnosed as Ewing's sarcoma, and 2 cases of solitary myeloma. Unanticipated long-term survivals followed irradiation.—*Arno W. Sommer, M.D.*

Harmer, W. Douglas. Treatment of cancer of the larynx by interstitial radium needles. *Brit. M. J.*, Oct. 3, 1953, *2*, 735–741.

The author briefly reviews the clinical features of carcinoma of the larynx as well as the clinical staging. He considers three main stages: I. Early intrinsic, in which the lesion is strictly confined "inside the cavity of the larynx"; II. Advanced intrinsic, in which the tumor is very advanced, but without evidence of enlarged lymph nodes; and III. Extrinsic, when the tumor is not confined to the larynx.

The technique of the Finzi-Harmer operation is described. Essentially this consists of removal of most of the thyroid cartilage. For Stage I lesions 2 mg. radium element needles with active lengths of 32 mm., filtered by 0.8 mm. Pt, are placed vertically in the thin cartilage bed and sutured into place. One or two 1 mg. needles are placed transversely. The distance separating the needles is only 3–4 mm. The needles are left in place for seven days. The dose resulting from this is not indicated, but the author states that larger doses are employed for Stage II lesions. These are expected to receive a dose of at least 6,000 r to the anterior half of the vocal fold with a dose of at least 5,000 r to nearly all of the vocal fold.

The author has employed radium needles in the treatment of laryngeal cancer in 120 patients since 1924. Most of these had Stage II lesions. Three patients were lost sight of or had been treated less than three years ago so the results given are based on 117 patients. Between 1924 and 1936 the operative mortality was 8.5 per cent and between 1936 and 1951 it was 6.1 per cent. The five year survivals were as follows: Stage I, 87 per cent; Stage II, 37 per cent; and Stage III, no survivors.—*C. R. McIntire, M.D.*

Finney, R. Dupuytren's contracture; a radiotherapeutic approach. *Lancet*, Nov. 21, 1953, *2*, 1064–1066.

The author reports 25 cases of Dupuytren's contracture treated with planar radium molds over the area of the palmar fascia. A skin dose of 3,000 r was given, eight hours a day for eight days. A distance of 1.0 to 1.5 cm. was used. If contractures were present, a cylinder mold was applied.

The cases are divided into four stages according to the degree of involvement; from the first, with a minimal fascial nodule, to the fourth stage, with maximal contracture. Seventy-five per cent of the cases showed varying degrees of improvement both subjectively and objectively, by increased range of motion. The remaining 25 per cent showed no further progress of the disease. The cases in which full recovery occurred belonged to the earlier stages. Maximal improvement occurred by twelve months. No recurrence was observed.

This method seems to be as successful as radical surgery and to have a much lower rate of recurrence. The author suggests that there may be a place for irradiation with radical postirradiation surgery.

Histopathologic changes in Dupuytren's contracture resemble keloid formation in some respects. These changes are discussed at some length as well as the effect of irradiation on keloids, which has been used with good results for some time.—*George L. Sackett, Jr., M.D.*

Levitt, W. M. Radiotherapy in the prevention and treatment of hypertrophic scars. *Brit. J. Plast. Surg.*, July, 1951, *4*, 104–112.

Radiations cannot only induce the resolution of

hypertrophic scars but they can also prevent their occurrence. The radiologist's problem is to learn the dosage formula which will produce the desired result on the scar while avoiding the undesired effects on the skin.

The author approaches the dosage-formula problem by attempting to answer four questions:

1. What are the undesired effects of radiations on the skin?

The effects of radiations on the skin are considered under the headings of acute radiodermatitis, chronic radiodermatitis and late effects. The four degrees of acute radiodermatitis are *the first degree*, with a faint pink erythema, dryness of the skin, and epilation, if over a hairy part, *the second degree* with a bright red erythema, *the third degree* with blistering, and *the fourth degree* with deep ulceration. The effects of acute radiodermatitis are mainly inflammatory, those of chronic radiodermatitis are mainly hyperplastic, and those of the late effects are mainly atrophic.

2. Can the undesired effects of radiations on the skin be related to variations in the dosage formula?

A single application of roentgen rays or radium with suitable dosage produces a first degree acute radiodermatitis, the only sequel being a transient pigmentation with no late effects. Repetition of this same dose up to a first degree reaction, with a relatively small area of exposure and with sufficient recovery time between exposures, again results in a deeper and more prolonged but transient pigmentation, without risk of late effects. A third application leading to a first degree acute radiodermatitis again with a suitable recovery interval is apt to produce light persistent pigmentation and possibly a few telangiectases at a later date.

With a second degree dermatitis, clearing of the skin is usually complete, but there is the possibility of a light permanent pigmentation and, uncommonly, telangiectases. These late effects are almost sure to follow administration of a later second dose leading to a second degree reaction.

3. Can any principles be evolved from the observations under (1) and (2) above, which should govern our treatment?

A first degree reaction is absolutely safe and may be repeated once with a proper interval.

A second degree reaction should not be produced at all where the cosmetic result is the paramount consideration, unless resolution of a very unsightly scar is preferable to a few telangiectases.

The dosage recommended in preoperative and postoperative treatment varies according to field size, but in general is from 525 to 650 r (presumably as measured in air, although the author does not so state.) If this dose produces only a first degree reaction, it can be repeated after a proper interval without risk of late effects.

4. Can hypertrophic scars be satisfactorily prevented or treated within the compass of the limitations imposed by these principles of treatment?

According to the work of Glücksmann, in the development of a hypertrophic scar, there is round cell infiltration, followed by proliferation of connective tissue. Roentgen therapy reduces or suppresses round cell infiltration, and in turn connective tissue and epithelial proliferation are reduced or suppressed. Hence, irradiation tends to prevent scar hypertrophy by inhibiting early epidermal proliferation and by reducing the vascular supply and inflammatory cellular infiltration of the dermis. Dosage has to be sufficient to produce an appreciable vascular reaction. This requirement is fulfilled if the skin be taken up to or near a visible first degree reaction. The time factor is probably not important, provided the appropriate vascular reaction is produced.

The author gives as his principles of technique: (1) low kilovoltage, 50 to 80; (2) shortest possible treatment distance, 5 to 12 cm.; minimal surface area exposure obtained by accurate close covering with sheet lead; (4) the dose to be enough to produce faint erythematous (first degree) reaction; (5) an interval between first and second treatments of not less than two weeks for very narrow areas as in preoperative treatment, but as long as two to three months in larger areas as when developed keloids are being treated; (6) preoperative treatment to be given about a week before operation.

In preventive treatment the best results are obtained from a combination of preoperative and postoperative irradiation. With postoperative irradiation alone the scars are not quite as good. In treating developed hypertrophy, if the thickening is bright red and recent, the author gives a single exposure with the standard dosage, increasing this dose slightly if the scar is greatly raised above the surface. Where the thickening is less recent or pale, higher dosage must be used to produce results. Techniques in which the radiation is applied in small weekly doses or in repeated fractions at intervals are unsatisfactory in the treatment of scars.—*Samuel G. Henderson, M.D.*

Glücksmann, A. Local factors in the histogenesis of hypertrophic scars. *Brit. J. Plast. Surg.*, July, 1951, *4*, 88–103.

Histologically, hypertrophic scars and scar keloids are identical. The clinical distinction rests on the progress of the lesion: a true keloid tends to spread and not to undergo spontaneous regression, while scar hypertrophy remains more localized and after a time very gradually regresses. The early stages of hypertrophy and keloids are the same histologically and clinically. Since treatment in these early stages inhibits progress of a keloid, it is in practice almost impossible to determine whether a given condition is a scar keloid or simple hypertrophy.

In hypertrophy in the first or early vascular stage, cellular nodules of thin-fibered connective tissue are seen forming whorls around blood vessels. Elastic

fibers are absent and the overlying epidermis usually has flattened rete pegs. In the second stage, later on, the vascularity subsides, the fiber bundles increase in thickness and hyalinize, and the nodules become poor in cells, but elastic fibers are still absent. In a third stage, the fiber bundles coalesce and shrink, elastic fibers appear, and the scar may pass into an atrophic papyraceous state. In a progressive keloid the first stage described above persists for as long as the lesion is growing.

Experimental work by the author, and by his associates, Mowlen and Barron, showed that scar hypertrophy and scar keloids are due to a peculiar, spreading, proliferative inflammatory process elicited in sensitive persons by the presence of various particles acting as foreign bodies. These lesions are not, therefore, true tumors but a peculiar type of foreign body granuloma. These foreign bodies may be endogenous as hair follicles, keratinized debris and cystically enlarged displaced sweat glands, or exogenous as from blast injuries, cotton wool fibers, talcum powder, and other particulate foreign matter.

Other experimental work has shown that there is no reaction as long as epithelium intervenes between keratin or hair fragments and derma; when keratin comes into contact with the derma, a marked foreign body reaction ensues, with spreading perivascular infiltration and later perivascular fibrosis. It is concluded by Glücksmann that endogenous particles, like exogenous foreign bodies, may act etiologically as local factors in producing scar hypertrophy. Acne keloids can be adduced as parallels to keloids caused by endogenous particles, and ornamental keloids as examples of keloids produced by exogenous foreign bodies.

There is a certain tendency to scar hypertrophy in young people and in women of white races, and also in colored people. Scar hypertrophy and keloids tend to arise in sites covered by lanugo hair, and the three groups just named have much less terminal hair and much more lanugo hair. In addition to this, there must be postulated a systemic influence or an individual sensitivity as a prerequisite for scar hypertrophy. Whether the onset of puberty, of the menopause, or of pregnancy promotes keloid formation by a direct systemic affect, or indirectly by its influence on hair growth and differentiation, remains to be investigated more closely.—*Samuel G. Henderson, M.D.*

Fried, Carl. Über Röntgenbestrahlung der Thrombo-angiitis obliterans and verwandter arterieller Störungen. (Roentgen irradiation of thromboangiitis obliterans and related arterial disturbances.) *Strahlentherapie*, 1953, *91*, 243–255.

Sixty-eight cases of thromboangiitis obliterans and peripheral arteriosclerotic conditions of a similar nature were treated by roentgen irradiation. Generally, and apparently preferably, a long, narrow field was used to irradiate the peripheral nerves with a dose of 160 r (180 kv., 0.5 mm., Cu, 50 cm. f.s.d.) every three days until clinical benefit was obtained. This meant a total dose of 1,200–1,600 r in many cases. In addition, most cases received irradiation to the adrenal regions: 200 r per 6×8 cm. field per dose to a total of 800–1,200 r.

Roentgen therapy relieved pain relatively quickly, well and lastingly. Other subjective and objective evidences of arterial disease showed improvement: gangrenous areas that were not too extensive developed demarcation, fresh granulations, and in many cases healed. Roentgen therapy also improved operative results in arterial disease.

Roentgen therapy must be counted as symptomatic, but nevertheless of greater value than generally conceded. Patients under forty-five years of age and with symptoms for less than twelve months have the best chance of improvement. However, even patients over seventy years of age and with symptoms of from two to eight years' duration were benefited. Remissions of symptoms lasted as long as two to five years. —*Henry G. Moehring, M.D.*

Kaplan, Ira I. A study of effects of x-rays on the grandchildren of women who have been irradiated for the treatment of female sterility. *J. Obst. & Gynaec. Brit. Emp.*, Dec., 1953, *60*, 872–877.

In refutation of the thesis that irradiation to the ovaries of women might produce abnormal offspring in second and future generations, the author presents the following interesting follow-up study:

Of a large group of married females treated for sterility by irradiation of the ovaries (and in some cited cases, pituitary and thyroid), 252 successfully responded and bore 293 normal children. Eighteen of these children have subsequently married and produced 14 normal living children. These 14 children represent the third generation grandchildren of the originally irradiated sterile women.

As a result of this study, the author feels justified in stating that irradiation when properly administered for female sterility is harmless to the mother, her children and subsequent grandchildren—*Walter T. Hileman, M.D.*

Böhmer, E., and Heite, H. J. Über den Einfluss der Strahlentherapie auf die Lebensdauer von Mykosis fungoides-Kranken. (The influence of radiation therapy on the longevity of patients with mycosis fungoides.) *Strahlentherapie*, 1953, *92*, 203–211.

Statistical study of 153 case histories of patients with mycosis fungoides showed that, no matter whether the cases were classified on the basis of their original morphologic appearance or their subsequent course, radiation therapy increased life expectancy.

However, the increase was not enough to be counted as statistical proof that radiation therapy prolonged life.

Without regard for whether radiation therapy had been administered, longer life expectancy could be statistically proved for patients whose disease course showed spontaneous remissions as opposed to those who continuously had some manifestation or other of the disease.

Radiation therapy evidently can change a malignant, progressive form of mycosis fungoides into a less malignant form which approaches the type with spontaneous remissions.—*Henry G. Moehring, M.D.*

Zuppinger, A. Bestrahlung und vegetatives Nervensystem (v. NS.). (Irradiation and the vegetative nervous system. *Strahlentherapie*, 1953, *92*, 364–367.

Some sort of stress reaction undoubtedly follows irradiation. Many observations indicate that this is not the mechanism of the systemic reactions. One of the chief tasks of radiation biology is, however, to discover the substances which *do* produce the systemic reactions. A promising working hypothesis is based on modifying radiation reaction by altering the state of the vegetative nervous system before and during irradiation.—*Henry G. Moehring, M.D.*

Birkner, Rudolf, and Trautmann, Johannes. Über die Abhängigkeit psychischer, Schlaf- und genitaler Funktionen von den vegetativen Steuerungszentren im Hypothalamus und die Beeinflussbarkeit dieser Funktionen durch Röntgenbestrahlungen des Zwischenhirngebietes mit kleinen Dosen. (The dependence of psychologic, sleep, and sexual functions on the vegetative centers in the hypothalamus and alterations of these functions by roentgen irradiation with small doses to the midbrain.) *Strahlentherapie*, 1953, *91*, 321–350.

One hundred twenty more or less unselected cases were given small doses of roentgen radiation (180 kv., 0.35 mm. Cu, 0.74 mm. Cu hvl., 30 cm. f.s.d., through 6×8 cm. temporal fields with 30–50 r per dose, total dose per field 150–200 r, average target dose of approximately 150 r) to the midbrain. Spontaneous expressions by the patients of the effects on their general psychological state, their sleep, and their sexual function were used to adjudge results of such therapy.

Psychologic changes consisting generally of improvement in the sense of well-being, occurred in 49 per cent; changes in sleep, generally loss of wakefulness and sounder sleep, occurred in 51 per cent; and changes in sexual function, in the direction of restoration of theretofore absent libido, occurred in 37.5 per cent. The duration of the changes varied from a number of days to several years. Other vegetative nervous system functions (effects on blood pressure, on blood sugar levels, etc.) were noted so irregularly that they could not be counted as the result of irradiation of the midbrain.

The changes in psychologic state, sleep, and sexual functions produced by irradiation of the midbrain bear interesting similarities to those observed in a series of 673 cases of brain injuries (Sturm and Wilke). They also coincide with effects anticipated on the basis of animal experimental evidence.—*Henry G. Moehring, M.D.*

RADIOISOTOPES

Brucer, Marshall, Andrews, Gould A., and Bruner, H. D. A study of gallium^{72}; summary and conclusions. *Radiology*, Oct., 1953, *61*, 534–536.

A rather intensive study on the use of gallium^{72} has been undertaken by the staff of the Medical Division of the Oak Ridge Institute of Nuclear Studies. The opinion arrived at after over two years of study is that gallium^{72} is not a therapeutic agent in cancer of bone, for the following reasons:

1. Although the isotope was highly concentrated in many areas of tumor, in every case areas of low concentration occurred.
2. Because of the short half-life of the isotope, the relatively high concentration in tumors develops after most of the radiation energy has been expended.
3. Undesirable total body irradiation effects become prominent at subtherapeutic dosage levels.
4. Development of chemical gallium toxicity was a limiting hazard in the long-continued dosage. —*Donald N. Dysart, M.D.*

Brucer, Marshall, and Bruner, H. D. A study of gallium^{72}. I. Physics and radiation characteristics of gallium.^{72} *Radiology*, Oct., 1953, *61*, 537–543.

Gallium is a member of Group III B in the periodic table and has an atomic number 31 and a average atomic weight of 69.27. In pure form it is a bluish white metal with a melting point of 29.78°C. and a boiling point close to 2,000°C. There are at least ten isotopes of gallium but only two, Ga^{67} and Ga^{72} are useful, the former has a half-life of 78 hours and the latter of 14.30 hours. Production of Ga^{72}, which is the one being studied, is by the thermal neutron reaction.

The decay schemes worked out and dosage calculations showed that the beta-ray dosage is 20.62 rep/mc. of Ga^{72} completely decaying in 1 gram of tissue, and the gamma-ray dosage for a standard size man equals 58.41 r/mc. (complete disintegration) in 1 gram of tissue in the center of the body.

The hematological picture was used as the method of assessing the radiotoxic effects of the therapeutic amounts used. In general, 20 mc. of Ga^{72} citrate were injected intravenously twice a week.

Four main sources of radiation hazard which demanded special attention were encountered and procedures and methods of handling the gallium were developed in order to reduce the exposure to safe levels.

Assay and sample counting procedures were standardized resulting in negligible exposure of personnel.—*Donald N. Dysart., M.D.*

Perkinson, Jesse D., Jr., Eldridge, James S., and Cooper, Betty M. A study of gallium^{72}. II. Gallium chemistry of biological interest. *Radiology*, Oct., 1953, *61*, 543–545.

The basic chemistry of gallium is discussed. The criteria for finding a compound both biologically acceptable and easily synthesized at high levels of radioactivity are listed. Gallium citrate was found to meet these criteria as it could be prepared quickly and easily in sterile solution. The procedure of handling radiogallium citrate is outlined.—*Donald N. Dysart, M.D.*

Perkinson, Jesse D., Jr., and Ingols, Robert S. A study of gallium^{72}. III. Effect of internal irradiation on respiration of rat liver slices. *Radiology*, Oct., 1953, *61*, 545–550.

By determination of the oxygen consumption of liver slices from rats who received a mixture of stable gallium and gallium^{72} citrate, and comparing these results with similar determinations in a control group and a group given just stable gallium, the authors attempted to learn whether a biological effect of radiation could be used as a basis of comparison for internally administered radioisotopes.

It was shown that the oxygen consumption of rat liver slices was inhibited by internal radiation from Ga^{72}, in relation to dosage. Stable gallium alone will produce slight inhibition.

The authors make no attempt to correlate their preliminary results with a physical expression of radiation dosage.—*Charles L. Stevenson, M.D.*

Bruner, H. D., Cooper, Betty M., and Rehbock, Donald J. A study of gallium^{72}. IV. Toxicity of gallium citrate in dogs and rats. *Radiology*, Oct., 1953, *61*, 550–555.

The authors report the results of their investigations on the toxicity of gallium citrate in dogs and rats. Their experimental procedures are outlined and the results recorded.

Clinically the metal seemed to mainly affect the dogs' gastrointestinal tract and kidneys—with an acute debilitating disease picture, terminated by uremia.

The ten day lethal dose for rats following intravenous administration was found to be greater than 220 mg. Ga/kg. body weight; the fifteen day LD_{50} for dogs, 18.2 mg. Ga/kg. Studies by other workers have shown that man can probably be grouped with the dog, although more resistant. However, because of the great differences in sensitivity demonstrated between various species, it is felt that no estimate of probable toxicity for man can be made from the work done thus far on experimental animals.—*Charles L. Stevenson, M.D.*

Bruner, H. D., Perkinson, Jesse D., Jr., King, E. R., Andrews, Gould A., Nash, Joe B., and Brucer, Marshall. A study of gallium.^{72} V. Distribution studies on gallium^{72} in rats. *Radiology*, Oct., 1953, *61*, 555–570.

The authors undertook a series of experiments on rats preliminary to the use of gallium in the treatment of human neoplasms. The technique of handling the experimental animals, counting system for the radiogallium, dosages, and various compounds employed are described in detail. Distribution data on each of three gallium compounds are presented.

In general, there was a high differential absorption ratio for bone in the case of the chloride and citrate complexes, with gallium alizarinate giving a high differential absorption ratio for liver and spleen. Rat data indicated that the chemical preparation of gallium citrate is suitable for use in clinical studies.—*Michael J. Healy, M.D.*

Andrews, Gould A., Root, Samuel W., and Kerman, Herbert D. A study of gallium^{72}. VI. Clinical studies with gallium^{72}. *Radiology*, Oct., 1953, *61*, 570–588.

Because of the known selective deposition of radiogallium in bone, especially the centers of osteogenic activity, the authors undertook a study of its effect on a series of primary and metastatic human bone neoplasms. The hematologic picture was used as a criterion of tisssue and whole body tolerances to doses ranging from 10 to 100 microcuries administered intravenously.

Localization studies included external radioactivity assays, biopsy with gross and microscopic autograms, and similar studies on autopsy material, when available. Clinically the authors encountered difficulty in evaluating chemical versus radiation effects since there has been no previous human experience with stable gallium.

The profound bone marrow depression encountered is characteristic of, and probably due to radiation. Dermatological changes encountered are probably due to stable metal toxicity, with the gastrointestinal symptoms probably being due to both factors.

In all, 21 patients were studied and the pertinent clinical and tracer data are given in each case. In general, there was a distinct tendency for gallium to localize in areas of bone activity, as expected. Fairly high levels also were noted in normal liver, spleen and bone marrow, the explanation for this fact being forthcoming.

The authors were impressed by the almost complete lack of clinical improvement following gallium treatment. They feel, however, that it may be a valuable element for the study of biochemical and metabolic factors related to bone tumors.—*Michael J. Healy, M.D.*

Bruner, H. D., Gray, Joe, Root, Samuel W., and Brucer, Marshall. A study of gallium^{72}. VII. Studies of the urinary excretion of gallium^{72} in man. *Radiology*, Oct., 1953, *61*, 588–590.

Only minute excretion of Ga^{72} was observed via the feces. Most of the urinary excretion occurred in the first 24 hours. The total amount excreted was usually 25–50 per cent of the dose. There was individual variation in retention of the metal. No saturation effect was apparent and no genitourinary damage was evident in humans.—*William A. Goodrich, Jr., M.D.*

Brucer, Marshall, Andrews, Gould A., Rehbock, Donald J., Root, Samuel W., and Gray, Joe. A study of gallium^{72}. VIII. Autopsy studies of distribution of gallium^{72}. *Radiology*, Oct., 1953, *61*, 590–595.

Distribution among tissues and within individual organs was highly variable. Some lack of uniformity is technical and some is due to the process of excretion. Hence, a concentration is found in the urinary system, as well as in bone, tumors (both primary and secondary), liver, spleen, adrenal, lung, and the gastrointestinal tract.—*William A. Goodrich, Jr., M.D.*

Gallimore, John C., Jr., Boyd, George A., Andrews, Gould A., and Brucer, Marshall. A study of gallium^{72}. IX. Autoradiographic studies. *Radiology*, Oct., 1953, *61*, 595–602.

A series of roentgenograms, autoradiographs, and photographs of gross specimens obtained from human patients is presented. In the authors' opinion, these studies have contributed information not obtainable by other methods, in that they have shown in detail the distribution of gallium in some situations in which routine tissue essay methods are not sufficiently discriminating. They have also served to emphasize the extremely uneven distribution of gallium in neoplastic metastases.—*A. R. Watson, M.D.*

Bruner, H. D., Hayes, Raymond L., and Perkinson, Jesse D., Jr. A study of gallium^{72}. X. Preliminary data on gallium^{67}. *Radiology*, Oct., 1953, *61*, 602–612.

The authors have carried out studies on Ga^{67} in the belief that the metal's bone seeking properties had not been fully exploited by the low specific activity Ga^{72} available.

Thirty-two male white rats received carrier free Ga^{67} by the intravenous route. These were sacrificed at intervals of from one to twenty days, and the estimated cumulative dose in roentgenograms, the per cent retained, the per cent excreted, and the total organ content in per cent of the original dose in various tissues were recorded.

The urine and feces contributed about equally to the 39 per cent excreted in five days.

The femur, representative of bone, had a differential absorption ratio about 0.75 that of the spleen, while the liver lost much of the Ga^{67} activity it had picked up initially.

Since the results of this experiment differed significantly from previous studies on Ga^{72}, further experiments were carried out in an effort to determine if the absence of carrier gallium was solely responsible for these differences. In these experiments, therefore, all variables were minimized or controlled, and carrier dosage was varied.

It was found that under these circumstances, the carrier free pattern occurred when the dose of carrier was below 0.25 mg. of gallium per kilogram. Above this level the pattern associated with high doses of carrier was obtained. A therapeutically desirable part of the later experiments was a differential absorption ratio for bone which was ten to fifteen times higher than the second highest tissue. This difference was caused by a decreased percentage retention of the activity by the liver and spleen as the dose was increased, while the percentage retention of activity by the bone remained approximately constant.

These experiments suggest that stable $Ga^{69,71}$ may have to be added to the carrier free Ga^{67} preparations in order to secure the high differential concentrations of the radioisotopes in or around osteogenic neoplasms.—*A. R. Watson, M.D.*

Spalding, Charles K., Deamicis, Egilda, and Cowing, Russell F. Radiation exposure survey of x-ray and isotope personnel. *Nucleonics*, Sept., 1953, *11*, 46–47.

The authors have surveyed persons working in roentgenologic departments, isotope laboratories and clinics concerned with isotope therapy.

The increasing number of personnel exposed to ionizing radiation, the increased use of isotopes and the higher kilovolt techniques prompted a review of this field since their last survey five years ago.

Du Pont type 502 aluminum (1.0 mm.) dental

film packets filtered with 1.0 mm. copper for roentgen rays and 1.0 mm. cadmium for gamma rays were used. The filters covered about one-third of the film. The film packets were worn in an exposed position for one week after which they were developed and the density of the film was read on a densitometer.

This survey covered three years from January 1, 1950 to December 31, 1952.

Twelve thousand two hundred and twenty-five films were worn by 275 persons working in twelve roentgenologic departments. Sixty-seven, or 0.56 per cent, of all the films showed exposures greater than the permissible weekly dose of 0.3 r (300 mr). Exposures in this range were found to occur in persons who held children or dealt with older patients during roentgenography.

Twenty-eight thousand nine hundred and forty-seven films were worn by 580 persons working in isotope laboratories. All these laboratories were using less than 15 mc. of any isotope in any one week. The majority of these materials had very short half-lives. Twenty-three films showed exposures greater than 0.3 r. These were worn by personnel responsible for isotope preparation from the original stock shipment.

The isotope therapy investigations included the use of Au^{198}, I^{131} and K^{42}. The emitted gamma roentgen dose at 50 cm. would be 0.096, 0.105, and 0.708 r/100 mc./hr. respectively. It was concluded that a nurse might work for twenty minutes within 50 cm. of a patient receiving an injection of 100 mc. of Au^{198} without exceeding the safety limit of 50 mr. However, the survey of nurses has not been sufficiently large to ascertain their radiation exposure.

It is concluded that those who work in roentgenologic departments are exposed to a greater extent than those who work with isotopes. The authors emphasize the need for precautionary measures consistent with the increased use of isotopes.—*Frederick W. O'Brien, Jr. M.D.*

Grosch, Daniel S., and Sullivan, Robert L. The fate of radiophosphorus ingested by Habrobracon females. *Biol. Bull.*, Oct., 1953, *105*, 296–307.

Virgin female wasps of the *Habrobracon juglandis* species were fed radioactive phosphorus in substerilization doses with the object of determining the fate of the radioactive material. The biological half-life was found to be from four to five days and radiophosphorus present in the eggs was found to account for 60 per cent of the total loss. The eggs reached a peak of radioactivity on the second day with a subsequent sharp fall. The gamete-incorporated radiophosphorus appeared to be significant in determining the hatchability curve of the eggs during the first five days.—*Edward F. Dunne, M.D.*

Rawson, Rulon W., Rall, J. E., and Robbins, Jacob. Uses and misuses of radioactive iodine in treatment of cancer of thyroid. *A.M.A. Arch. Int. Med.*, Sept., 1953, *92*, 299–307.

Dramatic results have been reported with the use of radioactive iodine in the treatment of cases of metastatic cancer from the thyroid. Such a response is extremely uncommon, however, and much of the experience in this field has been discouraging. The poor results have undoubtedly been due in part to misuse of the radioiodine. Thus, this form of therapy is of no value when the tracer studies indicate inadequate uptake by the metastatic cells. It should not be used when the disease is localized to the neck and can be removed surgically. Administration of frequent small doses is another misuse since such doses are not only ineffective but also hamper subsequent treatment.

At Memorial Cancer Center patients are accepted for possible treatment with radioactive iodine when the disease cannot be removed surgically. If the metastases show minimal or no function with tracer doses, thyroidectomy is done either surgically or with radioactive iodine. Tracer studies are then made every four to six weeks for three to six months. At that time thiouracil is given and each six to eight weeks the administration of the drug is stopped and another tracer test is made forty-eight hours later. If urinary excretion in ninety-six hours is less than 40 per cent of the administered dose, the patient is considered a candidate for treatment.

The amount of radiation that will be delivered to the hemopoietic system and other extrathyroid tissues is calculated, and from this calculation and the estimated size of the tumor decision is made as to whether a cancerocidal dose of radioiodine can be delivered to the tumor without doing the patient serious harm. The maximum safe dose of radioactive iodine is then administered.

By following these criteria it has been demonstrated (1) that a large percentage of cancer to the thyroid can be made to assume certain functions of normal thyroid tissue, and (2) that certain cancers of the thyroid can be at least partially destroyed with radioactive iodine. Of 35 patients treated, 10 showed sustained objective improvement and 10 transient objective improvement; 8 were failures and 7 were too recently treated for evaluation.—*Leslie K. Sycamore, M.D.*